THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK JULY, 1913

Automatic Supply and Exhaust Ventilation for a Residence

A RECIRCULATING SYSTEM THAT MAKES USE OF AN AIR SEPARATOR.

An attempt to solve the problem of efficient and economical house ventilation on the lines of some of the latest advances in the art has been made in the new residence of Charles Cluthe, Sr., at Glen Ridge, N. J. The design includes an air recirculating feature, but it is one in which the impurities are first separated in a unique contrivance designed for the purpose. Mr. Cluthe has already

W. F. Staab, Architect.
RESIDENCE OF CHARLES CLUTHE, ESQ., GLEN RIDGE, N. J.

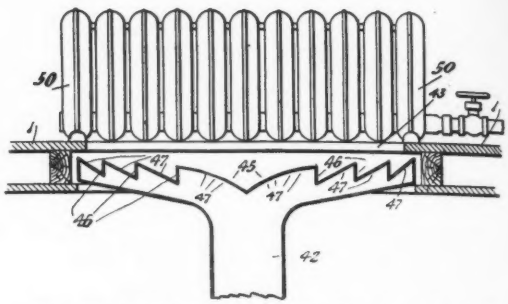
applied some of the features of this system in his former residence in Glen Ridge, which were illustrated and described in THE HEATING AND VENTILATING MAGAZINE for April, 1909.

The system here illustrated, which is entirely his design, is a combination direct and indirect plant. The vital feature consists of a so-called "air separator," designed to separate the impurities from the vitiated air, when it is then mixed with fresh, outdoor air, reheated and returned to the rooms. That portion of the air into which the impurities have been deposited is exhausted to the chimney.

THE AIR SEPARATOR

As the "air separator" is the heart of this system, it will be of interest to describe it in detail. It consists practically of two sheet metal boxes or compartments, one being intended to receive the exhaust air from the rooms and the other containing the reheating coils. Between the two compartments is located a water pan to supply the requisite humidity.

In the cycle of operation, the vitiated air from the rooms is drawn down through registers placed near the floor line and is carried through flues to a main exhaust duct in the cellar and thence to the "air separator." In this



ARRANGEMENT OF AIR SUPPLY OPENING BENEATH RADIATOR.

compartment the air is made to take a zigzag course down, up and down again, with the purpose of depositing the heavy gases at the bottom of the chamber. The lower part of the first chamber is funnel-shaped, with an opening at the bottom leading to the chimney. It is through this opening that the carbon dioxide and other gases flow to the chimney and thence outdoors.

The remaining air, which has retained much of its heat, passes over the deflector and past a fresh air inlet, where it is mixed with a certain quantity of outdoor air.

The course of travel is then over the water pan where it gathers oxygen as it kisses the water and into the compartment containing the reheater. At the top of this chamber warm air ducts

LIVING ROOM, RESIDENCE OF CHARLES CLUTHE, ESQ., SHOWING AIR SUPPLY OPENINGS BENEATH RADIATORS.

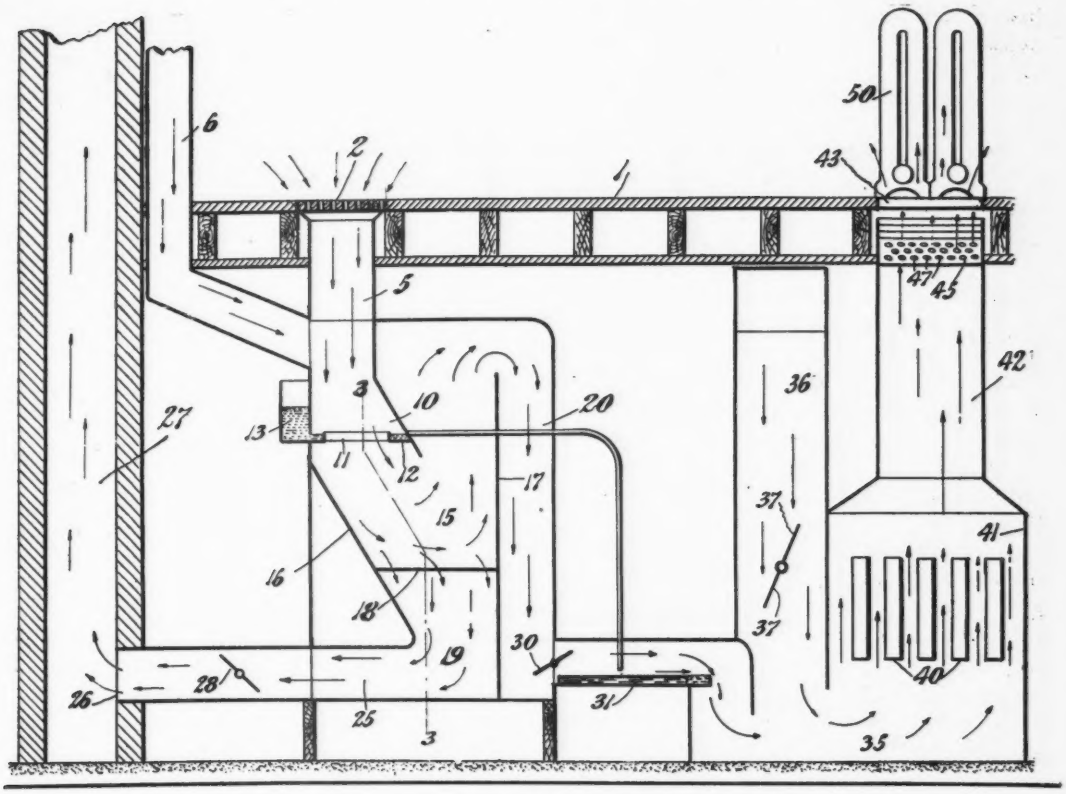


DIAGRAM OF "AIR SEPARATOR" SYSTEM DESIGNED BY CHARLES CLUTHE, ESQ.

carry the heated air through a separate system of ducts and flues to the rooms through specially constructed outlets placed directly beneath the radiators.

Thermostatic control is used to regulate the draft and check dampers in the boiler. the reheater coils and the fresh air supply. Additional dampers are installed for hand operation. In addition, the water supply for the humidity pan is automatically regulated by a float valve, the overflow draining into a small well which is used for no other purpose.

It will thus be seen that the system is entirely automatic throughout, at the same time being subject to a wide range of adjustment. For instance, the outdoor air supply can be entirely shut off in winter or this source of air supply can be used exclusively as in summer.

In further description of the operation of the gravity separator, it will be noted that the inlet pipe carrying the vitiated air to the first chamber leads downwardly in the chamber to a point below the separator box or chamber, while the outlet leading to the second box is at the top, the idea being that the current of air will pass downward and then up again over the side wall of the separator box which is, in effect, a baffle plate or wall.

In this change of direction, the heavy noxious gases will gravitate with the cooling of the air to the bottom of the box and pass down and out through the opening in the bottom to the branch conduit leading to the chimney. The desired downward movement of this air current is assisted by an inclined or curved deflector wall arranged beneath the point where the vitiated air first enters the box. The desired suction for carrying off the gases to the chimney is secured through the chimney draft.

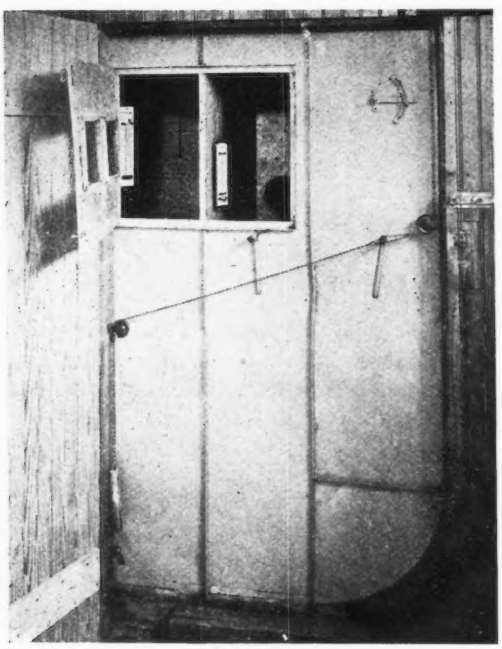
The idea of admitting the freshly-warmed air directly beneath the radiators is partly to avoid drafts due to the entrance of the air into the rooms. The outlets are designed to distribute the air as much as possible from the center towards the ends of the radiators, causing it to pass upward in approximately even quantities from end to end.

The system as installed is operated in connection with a hot water heating

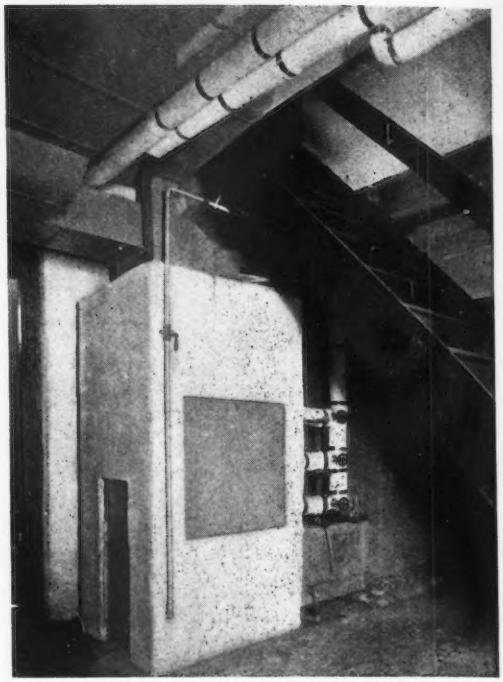
plant. A Progress boiler of 1,300 sq. ft. capacity, made by the Thatcher Furnace Co., New York, is installed, supplying, in addition to the indirect heating stack, twelve radiators having a total of 632 sq. ft. of surface. The indirect heater contains 400 sq. ft. of surface and is divided into three stacks, each separately valved, affording further regulation of the system.

While no figures are available just yet regarding the capacity and operation of the "air separator" its limits of adjustment are so wide that its serviceability is assured in meeting any ordinary requirement. The system as installed has been in use since early Spring and has given notable satisfaction, especially in maintaining the freshness of the air.

Mr. Cluthe is enthusiastic over the operation of his system. "It has already given great satisfaction," he said, "and it undoubtedly operates as intended, receiving the lower stratum of air from each room, separating the foul air from the fresh air by the law of gravity and sending the foul air underground to the chimney. I consider it the nearest approach to the human lung and I can easily set the apparatus to take care of 20 people or 200.



END VIEW OF FIRST CHAMBER OF "AIR SEPARATOR."
Exhaust Air Enters at Left and Settles at Bottom of Chamber.



SECOND CHAMBER OF "AIR SEPARATOR" CONTAINING REHEATING STACK.

"This summer I have installed a 16-in. fan in the heating stack and operating it at the second speed, commencing at 9.30 A. M., I pulled down the temperature 3 degrees and later maintained an inside temperature of 74° F. when the outside temperature was 87° F. Of course all doors and windows were closed."

The economy to be obtained from such a system depends, of course, upon the amount of air recirculated. In the present installation two-thirds of the air is recirculated, the other one-third being admitted through the fresh air inlet.

In point of cost, the system may be compared with that of an ordinary indirect system comprising air ducts, but in this case the radiator is concentrated in the center of the building and the extra cost of the "air separator," when commercially manufactured, will not be excessive.

Mr. Cluthe has applied for a patent on his design.

The architect for this residence is W. F. Staab, of Glen Ridge, N. J., who worked out the details of this unique installation. The heating work was done by Frank Larkin of Kaveny & Larkin, Montclair. Wm. Wickstrom, of Montclair, was the builder.

Operating Economies in Heating Large Factory Buildings

By Edward L. Wilder.

Read before the National District Heating Association, Indianapolis, May 27-29, 1913.

It is universally recognized that in all public service business not only must the company be able to do business at a reasonable profit but also that the company must be given an adequate service.

In selling steam for heating upon a meter basis, it is quite essential to good service that the customer use a reasonable degree of economy. The customer is interested primarily not in the steam he is purchasing, but in keeping his building at the proper temperature. If, through ignorance or carelessness he is wasteful in the use of steam; if, for example, in mild weather he leaves his heating system going full blast and opens all the windows to keep cool, his bills are bound to be high, and instead of being a booster for the heating company, he becomes a knocker. It is hard to estimate in dollars and cents the amount of harm that such a dissatisfied customer may do, but I venture to assert that the company would be much better off without his business. The methods by which economics may be effected in the use of steam for heating, are perhaps not quite so clear to the general public as in the case of the use of electricity for power, where, for example, a simple switch controls the consumption. It is well worth while for a steam heating company, therefore, to show their customers how to use steam economically; in other words, how to get the most service for the money they pay.

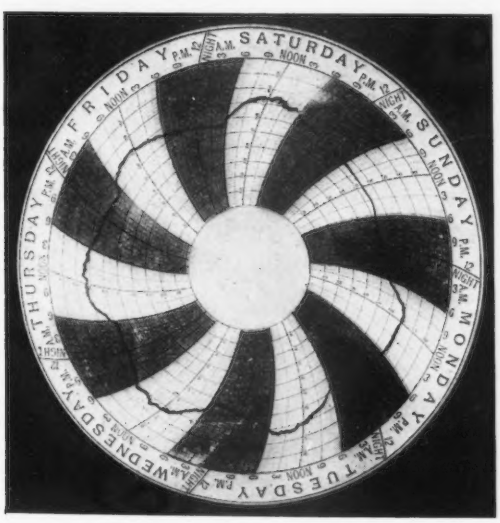


FIG. 1.—TEMPERATURE RECORD IN BRICK FACTORY BUILDING, WITH INTERMITTENT HEATING.

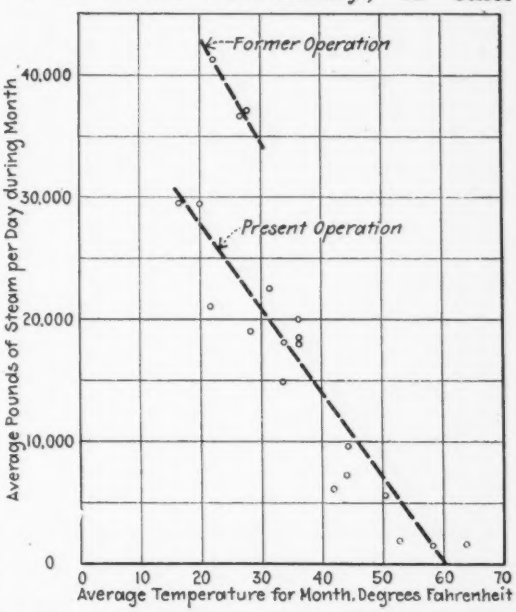


FIG. 2.—AVERAGE STEAM CONSUMPTION PER DAY FOR HEATING AUTOMOBILE FACTORY FOR EACH MONTH, PLOTTED WITH REFERENCE TO THE AVERAGE TEMPERATURE FOR THAT MONTH.

INTERMITTENT HEATING ADVOCATED.

No hard or fast rules can be made for the operation of heating systems. In general, however, if a building is closed up tight at the end of the day, and the steam turned off and not turned on until necessary for bringing up the temperature to the proper degree in the morning, an important step has been taken in securing economical operation. This, in the first place, is because with the steam shut off there will be a slower circulation of air within the building, which means a lower rate of heat transmission through the walls and windows for the same temperature difference. In the second place, the average temperature be-

tween the inside and the outside of the building will be somewhat lower. In the third place, if the heat is not turned off, the temperature is liable to rise, causing a greater heat loss during the night and a general opening of windows and doors in the morning in order to lower the temperature to a comfortable point.

VALUE OF RECORDING THERMOMETERS.

In studying the operation of heating systems, the installation of recording thermometers has been found very useful; and our recommendations for the operation of particular systems have been largely based upon the knowledge which we have obtained from a study of recording thermometer charts. Such a record is also very valuable for demonstrating to the customer the principles of operation recommended. If the building is large, the proper location of the thermometer is not always a simple matter. It should be placed where it will show the average condition, and some experimenting is usually required to determine this.

The Rochester Railway & Light Company has been able to effect very striking economics in the operation of the heating systems of two of its large steam customers, and it is my purpose to give some details regarding them.

ECONOMIES EFFECTED IN AUTOMOBILE FACTORY.

The first case is that of a factory used for the manufacture of automobiles. This is a well constructed brick building, four stories in height, and having a total floor area of approximately 60,000 sq. ft. All the heating is by direct radiation. The installation of a recording thermometer showed that the steam was left on the building all the time, and there was a decided rise in temperature during the night hours. Upon our recommendation care was taken to see that at the end of the working day all windows were closed and the steam entirely shut off, turning the steam on in the morning in time to make the factory comfortably warm at seven o'clock.

Fig. 1 shows a typical week's record of the recording thermometer, taken after our recommendations had been put into effect. The "sawtooth" character of the chart is very marked. Note how the temperature falls off gradually during the night hours and on Sunday, and how readily it responds when the steam is turned on about six o'clock in the morning. The temperatures of 70° F. and over shown during the afternoons were unnecessarily high for a machine shop. This is accounted for by the fact that the thermometer is placed in the center of the room, and the temperatures near the windows are without doubt somewhat lower than recorded. In general, the present operation of the system is satisfactory. The temperature record is for the week commencing Saturday, January 18, 1913, and the outside temperatures as recorded by weather bureau, are as follows:

	Outside temperatures. Deg. F.		
	Maximum.	Minimum.	Mean.
Saturday ..	51	30	40
Sunday ...	35	29	32
Monday ...	55	33	44
Tuesday ...	33	23	28
Wednesday	46	25	30
Thursday ..	47	30	38
Friday	39	31	35

In order to show the effect on the total steam used for heating, I have calculated the average pounds of steam per day used during a number of months, and have plotted these against the average outside temperature of the same months. The results are shown in Fig. 2. The upper curve is for the operation before our recommendations were put into effect. The lower curve shows the present method of operation, and covers a period of over two years. The saving averages 37%.

RESULTS OBTAINED IN GROUP OF FACTORY BUILDINGS.

The second case is a large group of factory buildings with a ground area of approximately 75,000 sq. ft. All the buildings are well constructed brick buildings, varying in height from five to seven stories. The heating is mainly by the fan system, and there is provision made for recirculating the air in only one of the buildings, which forms approximately one-quarter of the total heating load. Our preliminary investigation showed that the steam was left on the heating coils all the time, that the cold air openings were not closed at night, and that, if the weather was at all severe, the

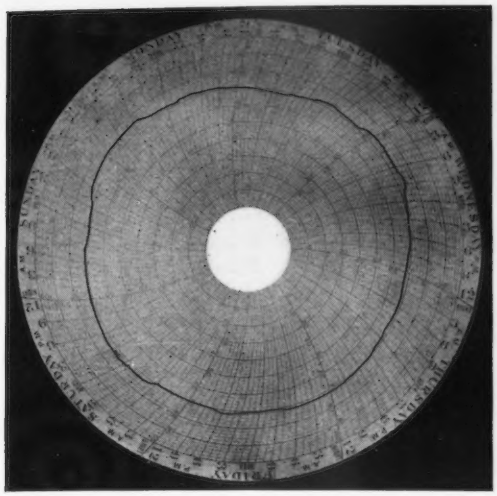


FIG. 3.—TEMPERATURE RECORD IN GROUP OF FACTORY BUILDINGS CONTINUOUSLY HEATED.

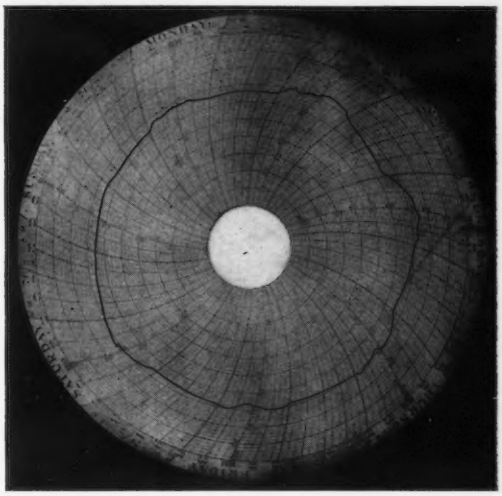


FIG. 4.—TEMPERATURE RECORD IN SAME GROUP OF FACTORY BUILDINGS WHEN INTERMITTENTLY HEATED.

fans were run continuously. The installation of recording thermometers in several places showed that the night temperatures often ran up to 80° F. and over. Several tests were run on the operation of the system during the night hours, and the following facts were developed.

With the cold air openings closed and the steam entirely shut off the heating system, the temperature in the buildings dropped at a rate of approximately 1° per hour in severe weather.

When the steam was turned on the coils but the fan not started, the natural circulation would hold temperature approximately constant. When the fans were started up, the temperature of the buildings responded rather slowly.

COMPARISON OF TWO CASES.

The conditions of this establishment are entirely different from those in the first one described. In the first case the work requires considerable muscular exertion, and if the temperature is a little low in the morning, no particular harm is done. In the second case, a great deal of the work is light bench work, a great many girls are employed in certain departments, and some of the work in progress would be ruined if the temperature were allowed to get too low. It was the opinion of the management that the temperature should not be allowed to get much below 65° F. at any time, and that 70° was the desirable temperature during the working hours.

SCHEDULE RECOMMENDED FOR OPERATION OF HEATING SYSTEMS.

Based on the data given above, we recommend to the management the following schedule for the operation of the heating system, which schedule was put in force. As we did not feel that we could afford to take any chances, we "played safe" in making up the schedule, with the idea of making modifications after more experience had been gained.

General Instructions.

5:30 P. M. Close cold air intake.
Stop all fans.
Turn off steam from all fan coils.

6:00 A. M. Open cold air intakes. Amount of opening to be regulated by condition of temperature and wind pressure outside.
If temperature in any building gets below 65° F., steam must be turned on and fans started in such building immediately.

IF OUTSIDE TEMPERATURE IS ABOVE 45° F.

4:00 A. M. Turn steam on fan coils.

6:00 A. M. Start fans taking air from basement, except in Building 7.

IF OUTSIDE TEMPERATURE IS BETWEEN 35° AND 45° F.

3:00 A. M. Turn steam on coil fans.

4:00 A. M. Start fans.

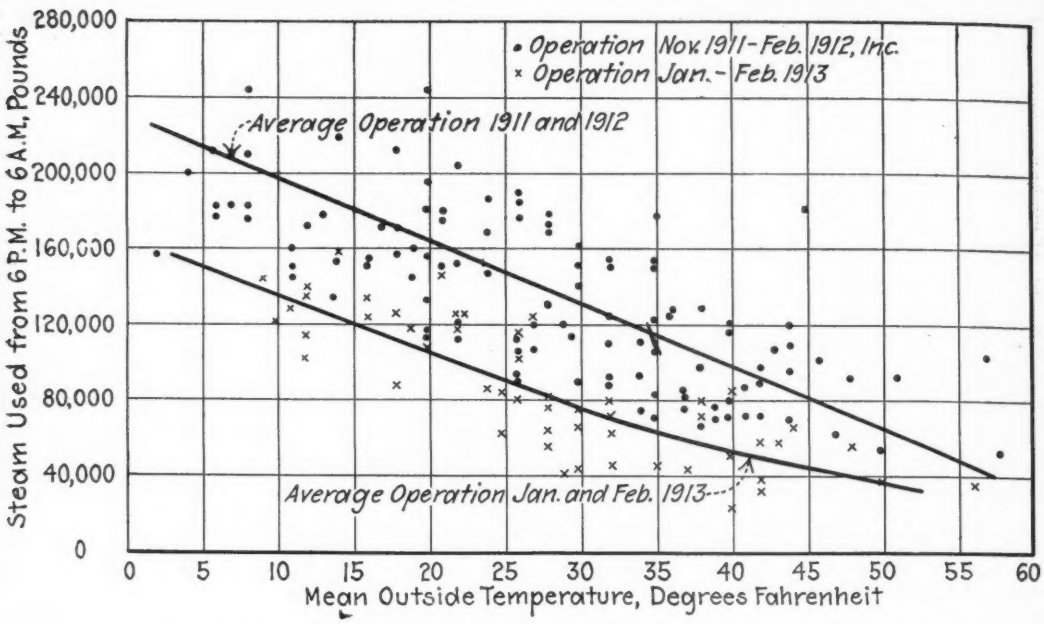

• Operation Nov. 1911 - Feb. 1912, Inc.
× Operation Jan. - Feb. 1913
Average Operation 1911 and 1912
Average Operation Jan. and Feb. 1913
Steam Used from 6 P.M. to 6 A.M., Pounds
280,000
240,000
200,000
160,000
120,000
80,000
40,000
0
0 5 10 15 20 25 30 35 40 45 50 55 60
Mean Outside Temperature, Degrees Fahrenheit

FIG. 5.—DAILY STEAM CONSUMPTION FOR NIGHT HEATING, GROUP OF FACTORY BUILDINGS.

IF OUTSIDE TEMPERATURE IS BETWEEN 25° AND 35° F.

6:00 P. M. Turn steam on coil fans.
3:00 A. M. Start fans.

IF TEMPERATURE IS BELOW 25° F.

6:00 P. M. Turn steam on coil fans.
1:00 A. M. Start fans.

Fig. 3 shows a chart from the recording thermometer taken before this schedule was put in force, and Fig. 4 shows a record from the same thermometer afterward. Fig. 3 shows an operation rather better than the average. Fig. 4 shows in a lesser degree the same "sawtooth" effect secured in the first factory described. Following are the outside temperatures for the week of the chart shown in Fig. 4:

	Outside Temperature, Deg. F.		
	Maximum.	Minimum.	Mean.
Sunday ...	35	29	32
Monday ...	55	33	44
Tuesday ...	33	23	28
Wednesday .	36	25	30
Thursday ..	47	30	38
Friday	39	31	35
Saturday ..	51	30	40

In order to determine what economics had been effected, I have plotted the steam used during the night hours against the corresponding outside temperature. This is shown in Fig. 5. The solid points show the old method of operation, and the crosses show the results obtained after our recommendations were in force. The curves drawn give the average of these points. The total steam used for heating shows an average decrease of 32 %.

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The subscription rate for the Industrial Arts Index is based on a sliding scale, the rate to each library, for instance, being determined by the number of periodicals subscribed for which are indexed.

Theory and Practice in Engineering Work

By Konrad Meier.

II—FORCED HOT WATER HEATING SYSTEMS.

With forced hot water systems the advantages of correct calculation are less evident than with gravity. The idea still prevails that the water must circulate if pumped through the apparatus. It will circulate, of course, but may not distribute properly or economically, as will be shown.

As in gravity work, the temperature range can also be increased beyond the customary rule of thumb practice, thereby reducing the water volume, the power and, occasionally, the pipe sizes. Besides, the apparatus can be made to reheat and respond more quickly. A range of 10° F. is often used. With 15° F. the power is already reduced to less than half. If the power is very cheap, one may at least save in piping. Differences of 20° F. and more can safely be assumed in most cases. The limit is given partly by the influence of gravity, which may become a disturbing factor in distribution where considerable differences in level exist between points of delivery. These could be taken care of by balancing the temperature heads through corresponding resistances, but only for a certain pump speed and temperature difference. With constant speed and water volume, as customary and most practical, the power of gravity will diminish with the variable flow temperature. Hence it will be impossible to calculate or adjust the system for any considerable range of general regulation.

The force of gravity must, therefore, be kept down by such small differences of temperature and resulting larger water volumes as will make the pressure to be exerted by the pump predominant, not only in a general way, but also locally, for all individual branch circuits. This temperature factor and the difficulties of equalizing and dealing with very small pipe sizes will make it impracticable to employ the same differences as are possible in gravity apparatus, but the limit has by no means been reached in average practice.

DISADVANTAGES OF LARGE WATER VOLUMES AT HIGH PRESSURES.

In general, the volume of water and the resistance against which it is to be moved should not be made greater than is necessary to bring the heat losses down to an economical point and to assure good distribution under all flow temperatures, even though the power can be obtained cheaply. The cost of rushing the water through in large volumes and at high pressures, which is still favored by many engineers, may not be felt in the coal bills to any extent where exhaust steam is utilized, but it will, nevertheless, cost some fuel, which will bear on the margin of profit. Besides, the powerful pumps and motors are more expensive and the wear and tear on the plant, while not easy to express in figures, is certain to be felt in the long run. It is easier to obtain a stipulated result with large water volumes handled at high speed, because it requires less careful calculation, but it will cost decidedly more to do so, both to install and to operate. This lays down the duty of the engineer whose part it is to assure the best results with the least amount of waste.

Accurate distribution of the heat carrier is, of course, only a part of the problem as a whole, but it is an important one. Deficiencies in some places involve excesses at others. These excesses are not only causing direct waste of fuel, but annoyances and other indirect losses as well. The water temperature must be kept high enough to suffice at the weakest points. This means more in forced systems than with gravity circulation, where the self-regulating power will help. Hence the water is liable to be kept considerably hotter than ought to be necessary and cause further waste in transit. It will be seen that the thermal

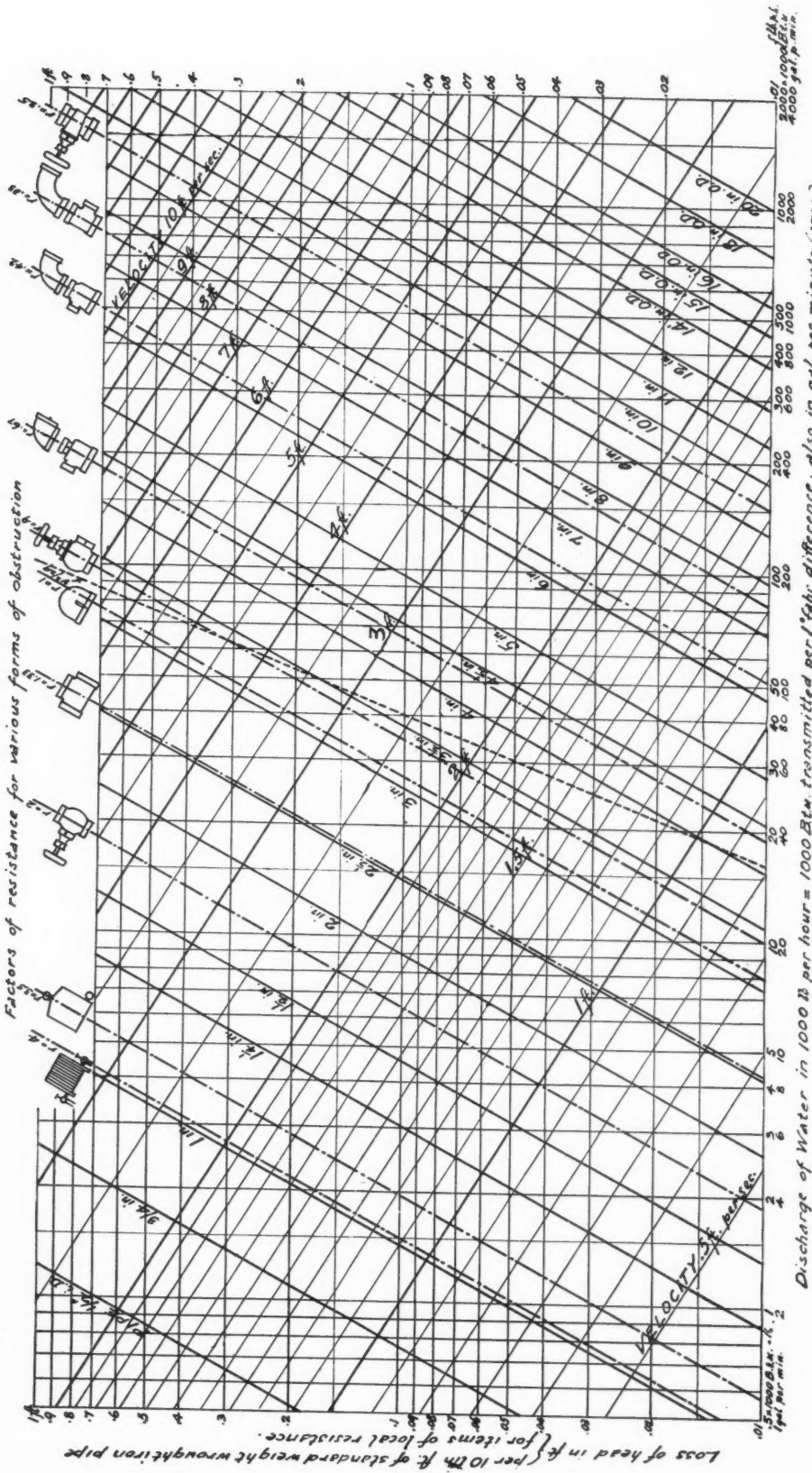
Loss of head in ft. per 100 ft. of standard weight wrought iron pipe for items of local resistance.
Discharge of Water in 1000 B per hour = 1000 Btu. transmitted per 1° fahr. difference; also in gal. per minute (appr.)
Factors of resistance for various forms of obstruction
VELOCITY 10 ft. per sec.
VELOCITY 5 ft. per sec.

FIG. 1A.—FORCED HOT WATER HEATING CHART, SHOWING LOSSES OF HEAD BY FRICTION AND LOCAL RESISTANCE.

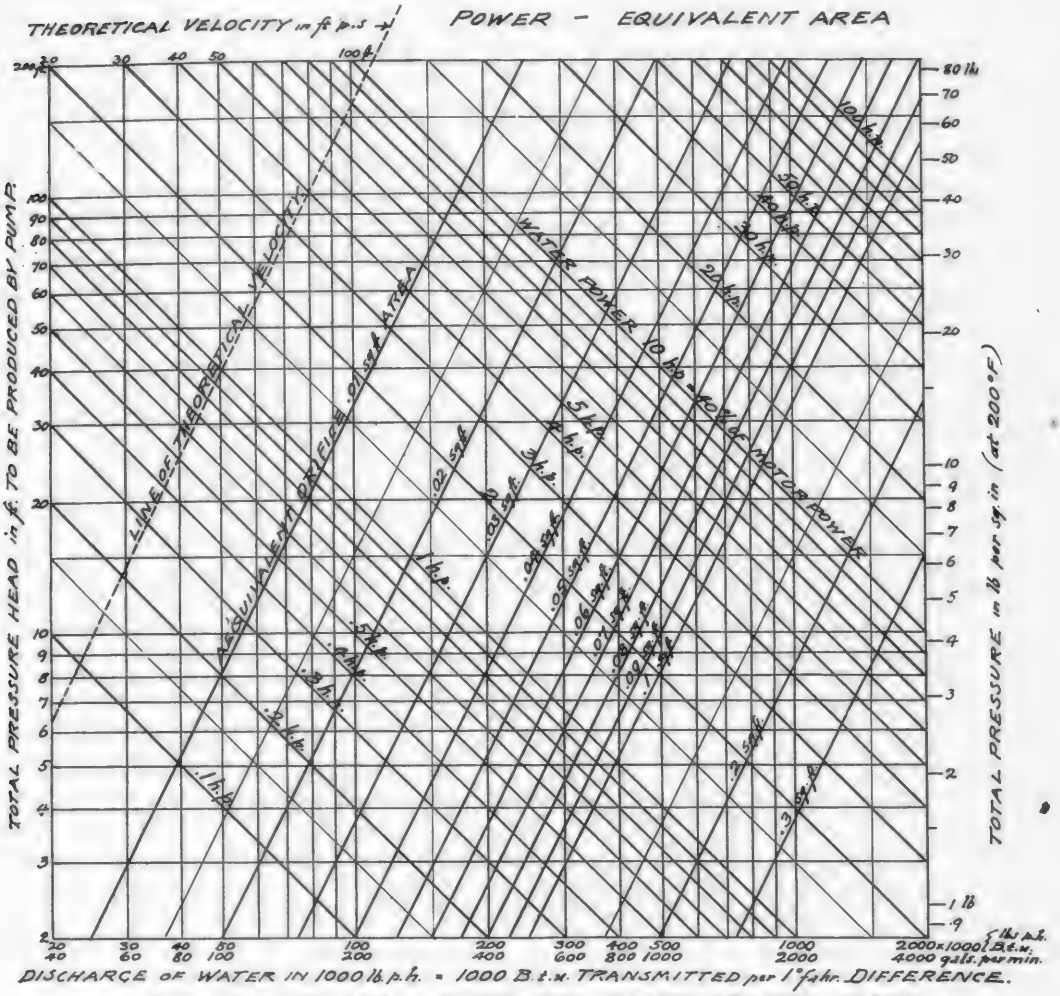
THEORETICAL VELOCITY in ft. p.s. →
POWER - EQUIVALENT AREA
TOTAL PRESSURE HEAD in ft. TO BE PRODUCED BY PUMP
TOTAL PRESSURE in lb per sq. in (at 200°F)
LINE OF THEORETICAL VELOCITY
EQUIVALENT ORIFICE OF SAME AREA
WASTE POWER 10 hp = KW OF MOTOR POWER
DISCHARGE OF WATER IN 1000 lb p.h. = 1000 B.t.u. TRANSMITTED per 1°F/hr. DIFFERENCE.
2000×1000 B.t.u.
4000 gals. per min.

FIG. 1B.—AUXILIARY FORCED HOT WATER HEATING CHART.

efficiency of a plant as a whole may be materially affected by poor distribution.

DIFFICULTIES IN ADJUSTING EXTENSIVE HEATING PLANTS.

Extensive heating plants, for which the forced hot water system is now generally used, are more difficult to adjust during operation than smaller apapratus. Throttling the delivery at one point changes the volume at others. It is often almost impossible to reach even a fair degree of accuracy by such means. Consequently, this laborious, time-consuming process is generally stopped short with more or less bluffing and self-deceit. It is mostly bluffing. Self-deceit is present insofar as even small differences of temperature, which are barely noticed, in reality mean a considerable discrepancy in the heat emission. As a matter of fact, large distributing systems can be equalized with more accuracy by previous calculation, appropriate design and thorough supervision to insure proper execution, than is likely ever to be reached by subsequent adjustments. The preventive method will save time in the end and considerable expense, as well as the mistrust and poor impression that are often created by the haphazard method before the plant can be turned over. Even the extravagent habit of making sure by giving twice is no safeguard in this respect. Aside from reasons of economy, there is a further advantage in good proportions of piping through their fool-proof permanency, while artificial adjustments are liable to be tampered with by incompetent parties.

CHARTS FOR FIGURING HOT WATER HEATING SYSTEMS.

The means to calculate accurately and with a reasonable amount of labor are at hand. The condensed chart (Fig. 1 a) from "Mechanics of Heating and Ventilating" is given herewith to illustrate the method. If the nature of the problem is understood, the application of the data presented in the sense outlined below will be found practicable and convenient. One can approximate or figure as closely as the case may justify and as judgment and experience may dictate. The main advantage lies in the consistent application of natural laws in place of thumb rules.

A preliminary sizing of the piping system, which may be carried out on the basis of an even rate of pressure loss per unit of length, or by any approximation table or rule based on the same volumes, must always precede the final equalization. The latter is accomplished by entering on a pipe schedule the pressures maintaining at each junction, or opposite sets of junctions, as figured from the losses on individual runs or even volume and diameter, starting at the pump and working towards the extreme points of heat delivery. As the total for each set of branches completing a circuit must be the same, the pressures at the junctions will give the difference or the head available for each individual point of delivery. These varying differences are made up by appropriate sizing or length of branches and, if necessary, by modifications along the mains, as the case may require.

A TYPICAL EXAMPLE.

In the example shown by Fig. 3, the sizes of mains were first assumed for an even rate of friction along the line of 0.1 ft. of head per 10 lin. ft., which gives 5 in. diameter for 1,500,000 B. T. U., or 100,000 lbs. (at 15° F. range) and 4 in. diameter for 810,000 B. T. U. or 54,000 lbs., etc. The preliminary sizes of branches are obtained in the same way, but a rough allowance is made at once, according to location. Those in favored positions are reduced or rounded down, while the end branches are rounded up to the next larger commercial pipe. From these sizes the heat losses in transit are then estimated and added to the heat to be carried, at least insofar as they may affect the volume and pressure. Any additional water that must be handled to cover these losses must pass through the mains as well as through the branches or be apportioned to the latter. As a rule, however, the losses in well-insulated mains are negligible.

The friction caused by the carrying of 1,500,000 B. T. U. at 15° F. temperature drop, or 100,000 lbs. of water per hour through a 5-in. pipe, to and from the pump up to the first set of junctions, is then obtained from the chart. The intersection of the lines for a 5-in. pipe and for 100,000 lbs. weight will give the velocity line (3.3 ft. per second) and, at the same time, on the intersecting horizontal line, will give the rate of friction per 10 lin. ft. (0.11 ft. of water column). For a sealed length of 32 ft., this will figure 0.35 ft. loss of head by friction.

The local resistances on this run are made up of three medium radius elbows and the boiler, which items are found at the intersections of the same velocity line of 3.3 ft., with the respective dash and dot lines for the factors of resistance. The elbows will cause $3 \times 0.08 =$ 0.24 ft. and the boiler, 0.70 ft. loss of head. The sum of friction and obstruction to the first set of junctions is, therefore, $0.35 + 0.24 + 0.70 = 1.29$ ft. of water column, as entered in the circle. The items for one run of even volume and diameter can thus be read conveniently from the same line and added right along.

Figuring the next run on the main, we find, for 1,435,000 B. T. U., or 95,700 lbs. carried a length of 45 ft. through the same size pipe, with two straight tees, $0.45 + 0.12 = 0.57$ ft. of loss. Added to the first sum, this makes up the 1.86 ft. marked in the second circle. Continuing in this manner, the total head up to the extreme branch, including its radiator and valve, is found to sum up 8.1 ft. of head, which may be accepted as the total to be produced by the pump. The nearer branches must now be sized so as to cause enough friction to make up or approximate this same total. Unless this is done, a larger volume will

pass through them than intended, which will increase the resistances in the mains up to those branches and leave a smaller margin of pressure for those beyond, and thereby curtail their delivery.

VARIOUS METHODS OF EFFECTING EQUALIZATION.

The example indicates various means to effect equalization. For the first branch the use of a trombone coil is resorted to, which is figured as pipe line and adds to the friction. If a coil would be objectionable, a loop in the connection might serve, if not otherwise long enough. In this case, the riser also gives

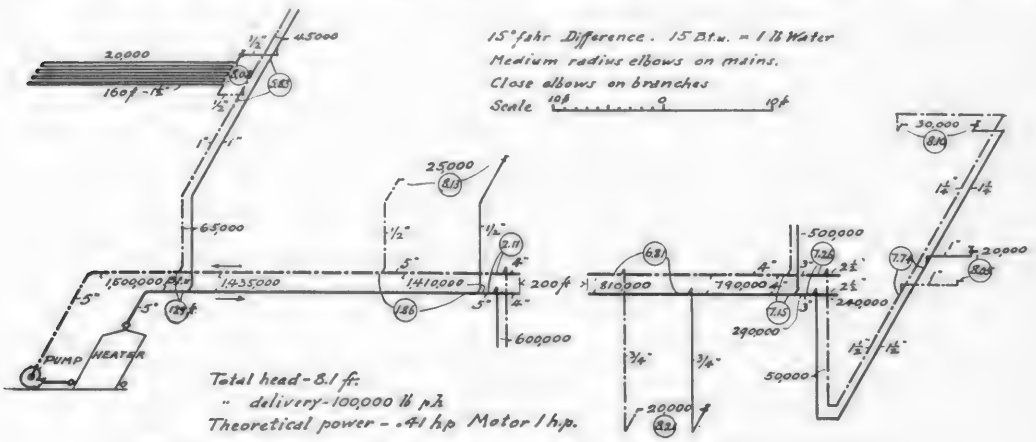

FIG. 3.—EXAMPLE OF FORCED HOT WATER HEATING LAYOUT.

opportunity to consume excess pressure. The second circuit taken directly from the main, must make up all of the difference by friction in the branches, hence they are smaller than the next set, which is a considerable distance further away. Those at the extreme end are shown to be still larger. A variety of ways are practicable for graduating resistances to suit the local needs, as previously indicated. The above should suffice to show the possibility of making up large differences by natural means. In some cases, however, they would be too extreme to be met by friction and it becomes necessary then to adapt the method of piping to these requirements. In fact, the general disposition should always be made with a view to aiding in that sense.

It is not essential to carry equalization as far as shown by the above example, but it is important to secure at least a rough approximation throughout and a somewhat closer one between branches on the same riser or branching main, where the differences are relatively smaller.

With overhead distribution and wherever the flow and return mains take a different course, the resistances will have to be calculated and added up separately. The idea of making the total pressure drop equal for all individual points of delivery remains, of course, the same and must always be borne in mind.

The auxiliary chart, Fig. 1 b, applied to the same example, now gives at the intersection of the lines for total head and total weight (8.1 ft. and 100,000 lbs.) a theoretical power of 0.41 H. P. for moving the water through the pipe system. For driving the pump, it will take about twice the power, according to the efficiency of the machine. This chart gives also at the same intersection the equivalent area (0.02 sq. ft.) which is the smallest frictionless nozzle area through which the water could be passed at that pressure. The corresponding theoretical velocity (23 ft. per second) is read at the intersection of the line for pressure with the dotted diagonal, using the upper scale.

On the left margin is another scale, convertinfg the pressure in pounds per square inch. The data given by this chart and the initial velocity given by the other enable the designer or manufacturer to select a pump that will be adapted to these conditions of pressure

and speed, thereby securing the highest efficiency and the least consumption of power.

The systematic calculation of pressure losses will naturally lead also to the elimination of useless resistances where the head must be kept down and will generally result in a lower total head, with consequent saving of power.

CHARTS FOR GRAVITY HOT WATER HEATING.

Fig. 1 a could also be used for gravity hot water heating, but the pressure due to temperature difference between flow and return and the height of water columns in question would have to be determined in each case, according to the range selected. To facilitate the calculation, separate charts have been worked out for three different ranges, 30° F., 35° F., and 40° F., in which the friction and resistance heads are expressed directly in feet of actual water column or actual height of heating surface above the boiler. Thus, for an elevation of 20 ft. between the center of the boiler and radiator, the resistance of the entire circuit should approximate 20 ft. as obtained by these charts. The auxiliary charts, in this case, give a convenient method for preliminary sizing with regard to height and distance from the boiler.

It would go beyond the limits of this article to present these three charts and the data that go with them. They will be found in "Mechanics of Heating and Ventilating," with complete application to the various methods of piping, showing their respective merits in a given situation and the practical possibilities of gravity systems in general.

(*To be continued.*)

Is District Heating Profitable to the Central Station?

By C. J. Davidson, of Woodmansee & Davidson, Consulting Engineers, Chicago, Ill.

Read before the National District Heating Association, Indianapolis, May 27-29, 1913.

The popular idea among the customers of the heating companies is that the gross receipts are all on the credit side of the ledger, for the assumed reason that exhaust steam is used, and that it is a by-product which would otherwise be wasted and, therefore, costs nothing. On the other hand, it is an equally popular opinion among central station men, or has been until recently, that there is no money in the heating business.

It is the purpose of this paper to analyze in part the divergency of opinion, and it is the desire of the writer that this paper may be of assistance to the central station manager in deciding whether in his particular case the investment for a heating system will produce a satisfactory net return. Our experience points to the conclusion that under proper conditions it is a good investment. It is, however, important that the conditions should be understood and, contrary to the popular opinion above referred to, it should be recognized that even under favorable conditions only a fair margin of profit may be expected.

WHEN HEATING BY EXHAUST STEAM SHOULD BE ATTEMPTED.

To illustrate one of the conditions under which heating by exhaust steam should not be attempted (and we are at this time only considering the subject from the standpoint of exhaust or by-product steam): We were at one time employed to take charge of a street railway power plant in a small city. A 24-in. by 48-in. non-condensing Corliss engine had been arranged to exhaust into the heating system in the office, paint and carpenter shops having about 1,000 sq. ft. of the heating surface. The total cost or legitimate credit to the station on account of this service would not have exceeded $300 per year. It was necessary to operate the engine against a back pressure of 5 lbs. It ran at 90

R.P.M., therefore, the resistance equalled approximately 50 I.H.P., or equivalent to about 33 K.W. at the switchboard. Assuming this lasted 200 18-hour days per year, and the operating cost per K. W. H. was one cent, then against this credit of $300 there would be a charge of $1,190, and still we are told that when steam from an engine is, in any case, exhausted to atmosphere, that it is necessarily profitable to use it for heating purposes, and the management in this particular case was laboring under this impression.

In another case we found a street railway manager had sold a live steam service to a wholesale grocery house. We connected this service to a single boiler, ran the boiler on a banked fire with the valves all closed, maintaining the required pressure, to determine the boiler losses, then ran this service only on the boiler. I am not in possession of the data now, but remember that the net cost of coal was about twice the price of the service.

In a recent visit to a studio which had been very artistically decorated I was shown a window seat with an open fret work underneath concealing a radiator —an example of how to treat unsightly objects. When questioned as to the effectiveness of the heating surface when so housed, I was shown that there was a hole in the wall behind the radiator containing a large fan. This service was in a cold climate and was sold on a flat rate at 25 cents per square feet of radiation for the heating season. There are some of the fallacies which have tended to bring the heating business into disrepute, but which it is well to know about. By far the greatest reason for failure, however—by this is meant the failure to earn dividends—is an attempt to sell steam or other heating service on a flat rate.

Much thought has been given to the construction of formula for estimating heating requirements, but we have been hopelessly unable to determine mathematically how much a window would leak without weather strips (we have known it to make a difference of 20%, in some cases 15% is allowed), how warm an invalid may want a room, or how often the occupant will open the windows in preference to shutting off the steam.

SERVICE SHOULD BE METERED.

We are not in any way interested in the manufacture or sale of any meter or measuring device, but it is our earnest advice to any one who contemplates going into the heating business on a flat rate basis to *"Stop, Look and Listen."* Applause is not expected from the hot water side of the house. We have no quarrel with the engineer who advocates hot water as a desirable heating medium. There are doubtless many things which may honestly be said in its favor, but many of the things in its favor are not said honestly, and to the central station man we say, remember every heating customer is your competitor because he can furnish himself the same kind of service you propose to furnish him. Also bear in mind that the majority of prospective customers are equipped for steam, and will not readily be persuaded to change their system, also that it is usually much easier to change from water to steam than from steam to water, and that steam can be metered and the heat from water can not—at least, we are not aware of a commercial method.

Now, one word further to illustrate the importance of the meter. We will cite two cases: One customer's requirements were estimated at $18 per month for the colder months. In December (the first month) this bill was $35. We carefully explained to him how to regulate and economize the service. The next month it was $15 and continued at about that figure.

In another case the service was to a double house, both sides of which were exactly alike. After a month's use one had a bill of $20, and the other about $40. The meters were found to be approximately correct; thereafter the original $40 customer had the lowest bill. I could cite cases of this kind indefinitely, but think this is sufficient to illustrate.

Another matter to which proper attention should be given is the hotel and restaurant that in order to take on as an electric and heat customer must have a certain amount of high pressure steam for laundry, steam tables, etc. This service should be avoided if possible. If it must be taken it should, above all others, be metered. Service of this kind, which

the proprietor thinks is worth from $15 to $30 per month, is usually worth from $100 to $300 per month, and you generally wish you did not have it at that, as the lines are hard to maintain and the customer is always of the opinion that he is being robbed.

POWER PLANT.

Whether or not you can advantageously furnish a heating service will depend on a great many things; among them the amount of business you can get. The answer is one of careful judgment. The wealthy banker who is one of your directors, and whose influence and example would help a lot, and who wants a main on his street, probably won't sign up, while the fellow who said he was not interested will be your first customer.

An important factor is the location of the station with reference to the load. There is no general rule, but long transmission does not pay. The character of your electrical load must be considered, also the type of prime mover you are operating. As an illustration: If you have several compound condensing engines you can so arrange them that each engine may exhaust either to the heating system or to its condenser, and each receiver may also be connected to the heating system. Bleeder type turbines lend themselves to this arrangement. On the other hand, if you are equipped with high pressure turbines the problem requires more careful study.

If your business is lighting only, and you have little or no day load, this condition is also unfavorable. If you are operating a non-condensing plant and you can sell practically all the exhaust steam, and you do not have to make up your heating requirements with a large amount of high pressure steam O. K., but if the heating system requires you to work against considerable back pressure, and the respective loads are such that you make up from the boiler direct part of the time and waste a portion of the exhaust at other times, the problem requires careful calculation.

It may happen that the property does not pay dividends and the addition of a heating system will not show the desired result, but if combined with a by-product ice plant (particularly in warm climates), that the desired results may be attained. This, however, requires careful analysis by a competent engineer and is only referred to in connection with its bearing on the heating problem.

Where the entire installation is new, including the power plant, special consideration of the apparatus and the selection of a type and size of engine or turbine best adapted to the particular condition may be the difference between success and failure. It should not be assumed that a properly designed and properly installed turbine can not be successfully used for this work. If, however, the heating requirement calls for nearly all the exhaust and the investment charge does not make it prohibitive, a compound engine will usually give better results. If the reciprocating engine is adopted it must have its cylinder ratios proportioned to suit the initial and terminal pressure. A detail of the considerations influencing the choice of prime movers is not within the scope of this paper.

STREET MAINS.

The kind and size of pipe, the kind of installation, how thick it should be—in other words, where the factors of operating losses and capital charges balance—how to protect insulation, what expansion point to use, whether to build in streets or alleys, to what extent tunnels should be constructed—if at all—also to what extent an attempt should be made to get condensate back to the plant, are among the many questions which must be answered; but the final and most important questions are, what will it cost? and, supposing this to be $100,000, will the average gross receipts pay for the steam used, the current repairs and taxes, and the salaries, a reasonable interest return, and at the end of some predetermined period—say twenty years—leave a surplus of $100,000 to replace the wornout system?

This is not quite all there is involved, as it is usually the case that a district heating system is of material assistance in securing electrical business, particularly by keeping out isolated plants. Just what this advantage amounts to depends on local conditions.

USE OF CAST-IRON PIPE FOR STEAM MAINS.

With reference to the question of pipe, while it is universal practice to specify strictly wrought iron, which is probably less affected by corrosion than steel it has, however, been our practice to use cast-iron, and we have found it cheaper, easy to make up in the trenches and it necessarily has a much longer life than either steel or wrought iron. Insulation and the necessary drainage for its protection depend on a great many things, but we have found that if the pipe is covered with a double thickness (about 3-in.) of magnesia or equivalent, securely placed and covered with tar paper and asphalted and laid in a well-constructed concrete box, which is drained to the manholes, excellent results have been uniformly attained. We know of no other material which can be depended upon to last underground as long as concrete.

In very congested streets where heavy mains are to be laid, and where it is desirable to get the returns back to the plant, tunnels may be employed to some extent. If these tunnels can be constructed by the open cut method and refilled the problem is easier, but in any case the cost is excessive and the advantages are not usually material.

RATES.

It is not our purpose to suggest a schedule or system of rates. In some cases there may be a public service commission whose function it is to regulate your charges. If this condition exists the rate should be made and approved by the commission before any investment is made. In any case it should be remembered that it is much easier to lower a price than it is to raise it, and it may happen that the average of all your steam delivered at customer's service will cost more than you had expected it to.

It has been our purpose not to discuss our subject from its technical aspect and we realize there are possibly cities where, on account of the broadmindedness of the people and other local conditions, some of our remarks may not apply, but in our experience we have found, from careful observation, that certain fundamental principles obtain, and the non-observance of the principles have been responsible for many failures, and it is some of these things which we have endeavored to point out, believing this would be of more interest to the manager who is not satisfied with his results, or to those who contemplate entering upon the heating business, than a technical discussion involving a vast array of figures. Furthermore, it has been our experience that a set of figures or statistics from the results obtained in one property may be absolutely misleading as applied to another on account of different local conditions.

Use of Gas Heaters in Residence Heating.

It is customary, in many instances, to make use of gas heaters for warming bathrooms. This practice is especially noticeable in the Gulf States where it is not uncommon to see these heaters also used in bedrooms for an hour or more at morning and at night during the warmer days of winter, when the house heating apparatus is not in operation. Gas heaters of this type are generally without any smoke flue to carry off the colorless, odorless smoke to the outside air. Commenting on gas heaters used in this way, Dr. W. A. Evans, writing in the "Chicago Tribune," declares that they are just about as vicious a device as is known to civilized society.

"Speaking generally," he adds, "when 1 cu. ft. of gas is burned, 2 cu. ft. of oxygen or as much as is contained in 10 cu. ft. of air, is used up and 3 cu. ft. of carbonic acid gas is generated. One can readily see that a gas stove running a few minutes in a closed room makes the air unfit to breathe. In the case of a bathroom, as the temperature of the air quickly gets over 80 deg., and as the water in the tub evaporates rapidly, the humidity of the room quickly reaches 70 per cent. or more. Fat men, or men with poor hearts, presently become dizzy."

Dr. Evans calls attention to the fact that in many cities, the ordinances require that such heaters shall have a stove pipe leading to the outside air. His conclusions are that "gas heaters without stove pipes in bathrooms should be made unlawful everywhere. Gas heaters with or without pipes are allowable in bedrooms where they are in use for periods not exceeding 15 minutes, on condition that the room be aired soon afterward."

NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS

WHO HELPS ME I HELP

Silver Anniversary Featured at 25th Annual Convention at Niagara Falls, June 22-26, 1913

An attendance worthy of the occasion, following a year of successful effort, and accompanied by a growth of 48 per cent. in membership, marked the silver anniversary of the National Association of Master Steam and Hot Water Fitters, which held its twenty-fifth annual convention at Niagara Falls, June 22-26, 1913.

While much of the work of this association's conventions is done in executive session, the report of President Edward B. Denny, gave a very fair idea of the widening of the association's activities and of the varied character of the problems it is now attempting to solve, such as the separate letting of heating and ventilating contract work, the direct sale to owners of heating goods, and the financing of small master fitters by local supply houses, which also frequently do the required engineering work.

Every seat was taken in the convention hall when President Denny called the assembly to order at 10:30 o'clock Tuesday morning, June 24. Joseph G. Reilly, alderman and acting mayor of Niagara Falls, and himself a master steam fitter, welcomed the delegates and said there was a big valve at the end of the street which was wide open. The roar of Niagara's rapids was ample evidence of this fact. After a fitting response by President Denny the organization of the convention was made complete by the appointment of the following committees:

CREDENTIAL COMMITTEE.
F. H. Meadows, Wisconsin.
W. H. Gottlieb, Washington, D. C.
George A. Scott, New York.
J. H. Lieber, Texas.
R. Knauer, Iowa.
J. A. Almirall, Treasurer, ex-officio.

APPEALS AND GRIEVANCES
F. G. Cartney, Utah.
W. H. Curtin, New York.
J. F. Garvey, Iowa.
Nathan Miller, Massachusetts.
R. G. Smith, Pennsylvania.

AUDITING.
J. F. Rutzler, New York.
N. P. Bishop, Connecticut.
Stewart A. Jellett, Pennsylvania.

CONSTITUTION AND BY-LAWS.
Wm. H. Oakes, Massachusetts.
S. A. Jellett, Pennsylvania.
J. A. Almirall, New York.

DISTRIBUTION OF REPORTS.
W. P. Thompson, Pennsylvania.
W. G. Schuwirth, Texas.
J. M. Gallagher, Tennessee.

NOMINATING.
A. E. Kenrick, Massachusetts.
John T. Sadler, New York.
J. A. Ziesse, Michigan.
J. F. Ahern, Wisconsin.
T. B. Cryer, New Jersey.

RESOLUTIONS.
N. P. Bishop, Connecticut.
G. L. Bradbury, Colorado.
A. Seidel, Ohio.

WAYS AND MEANS.
N. L. Danforth, New York.
Otto A. Wurm, Michigan.
H. G. Black, Pennsylvania.

President Edward B. Denny then read his address, which is given herewith substantially in full.

PRESIDENT'S ADDRESS

After extending a welcome to the members and guests, including the manufacturers and dealers, Mr. Denny referred to the deaths during the past year of John L. Earl, of Newark, N. J., who died January 18, 1913, and William B. Armstrong, of Albany, N. Y., who was killed in an automobile accident November 25, 1912. Continuing his address, Mr. Denny said:

"I think I may congratulate the members of our association on a general increase of prosperity during the past year. While it is true that in many places there is such unreasonable competition as to erase nearly all profit from contract business, there are many more places in which this condition has been succeeded by sane and right methods of cooperation, resulting in reasonable profits and a fair measure of prosperity.

"From the association standpoint this year has been one of the most prosperous in our history. In obedience to the resolutions adopted at our last convention our most persistent efforts have been in the direction of increasing our membership. These efforts have been successful to a degree that is most gratifying, the net increase since last June being 48 per cent.

"The new members have been gathered from nearly all parts of the United States. A few are from beyond the Rocky Mountains, many from the middle West, and a fair proportion from the Southern, Eastern and New England states. Our membership today is much larger than ever before in our history and never before have we been represented in so many cities.

"In advancing the work of the association, the president has given much time to visiting different parts of the country. In the various cities he has come in personal contact with more than 1,000 master steam fitters, helping them in many instances to better their local conditions and always enlightening them as to the work and methods of our national association.

"Early in the year it was thought wise to appoint as members of the Committee on Trade Relations three members located west of the Rocky Mountains and J. G. Sutton of San Francisco; J. G. Carthey of Salt Lake City, and W. B. Coffee of Tacoma were selected for such service. On December 18 I met with this sub-committee in Portland, Ore. In a conference lasting two days the territory was suitably divided so that each member could conveniently investigate violations of Trade Resolutions in his section and at the same time serve as a special membership committee. This has resulted in an improvement in the observance of Trade Resolutions and the addition of several new members in the Pacific States.

"In December I had the pleasure of addressing the Iowa State Association of Master Plumbers in convention at Sioux City, and in January the Illinois State Association in convention at Springfield. The results in these two states differ materially. In Iowa the value of our service was quickly and very generally recognized; applications for membership came to us from nearly 50 master steam fitters located in some 20 or more cities; trade conditions have greatly improved; cooperative measures have been adopted in many places and a state association has been organized.

"In Illinois there seems to be a lack of appreciation of our work and a general feeling of self-sufficiency which, for the present, makes it difficult for us to serve them except as our work benefits the fraternity at large. There are, however, some individual exceptions and we may reasonably expect that the value of our organization in the surrounding states of Michigan, Wisconsin, Indiana and Iowa will, sooner or later, be recognized by the master steam fitters of Illinois and lead them to desire affiliation with us.

"The report of the committee on standardization will show the progress made in several new directions and in the follow-up work incident to the going into effect on May 1, 1912, of the "1912 U. S. Standard" schedule of standard weight and extra heavy flanged fittings and fittings.

"While there has been continuous opposition in some quarters to the '1912 U. S. Standard' it is gratifying to know that it is already being extensively used and the list of manufacturers and dealers who are prepared to furnish fittings in accordance with the schedule is continually growing. Some of you may have been told that it was difficult to get the goods or that they could be secured only at special prices. This statement is an error.

"While it is a fact that some of the manufacturers have refused to furnish them and have endeavored by many and devious ways to make and foster such an impression, nevertheless, it has been possible at all times since May 1, 1912, to get all sizes and forms of flanged fittings as described in the schedule, and to get them at the same prices as were charged by such manufacturers for fittings made in accordance with other schedules.

"Former experience in efforts to establish uniform schedules prepared us for opposition in this effort. In fact, the opposition was well developed at the time of our last convention, soon after the schedule went into effect, but some of

CONVENTION PHOTOGRAPH, NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS, NIAGARA FALLS, JUNE 23-26, 1913.

the methods that have since been adopted by those who would thwart or delay the universal adoption of the schedule were not anticipated.

"It seems to me that there is but one way to meet all opposition, whether such position be open or covert, fair or unfair, and that is to stand firmly for its universal acceptance. Let us remember that every substantial reform has been won by persistent effort and some sacrifice, and let us each resolve that during the coming year we will do our part in firmly establishing the '1912 U. S. Standard.'"

CONFERENCES WITH THE MASTER PLUMBERS

"The joint committee of our association and the National Association of Master Plumbers has had several meetings and done some good work during the past year, a full report of which will be made to you by our board of directors. Believing that the work planned and partially completed by this committee will be of great value to the members of both associations, I recommend that the board of directors be authorized to continue it in the same manner if the National Association of Master Plumbers shall take like action.

SUB-CONTRACTING

"The subject of sub-contracting has received all possible attention during the past year. The action taken by the American Institute of Architects at their convention last December, the introduction and passage of laws in several States prohibiting the inclusion of plumbing and heating work in general contracts for State or municipal buildings, the printing and distribution of circulars on the subject, all these will be reported to you by the board of directors, as included in the work of the conference committee.

"The evils of this pernicious practice have in no wise decreased since our last convention, but it is a great satisfaction to find that there is a steady increase in the number of substantial concerns in our business who have discontinued the practice and now absolutely refuse to figure or work for general contractors, and it is particularly gratifying to find this condition prevailing in large sections of the country and, in two instances, covering whole States. As I said in our last convention, 'the most effective weapon we have against this evil is for all of our members to be loyal to our own resolutions, even to the limit of whatever sacrifice it may require. I believe that an uncompromising stand taken by all of our members would result in the elimination of our work from all general contracts.'

SMALL FITTERS AND THE SUPPLY HOUSES

"I have mentioned various lines of work that we are doing, all of it for the bettering of conditions for the steam fitting fraternity, but in none of these (except possibly in that of education) do we touch the sorest spot. The most difficult problem we have to solve is that of competition (both ignorant and vicious) which, in many places, precludes all possible profits from contract work and forces the master steam fitter to make his living from jobbing work, or some side line, or to go out of business. That this condition exists in your home city many of you will admit, but you have thought that yours was the exceptional case and will be surprised when I assure you that it exists in nine cities out of ten throughout the whole country.

"One of the direct causes of this almost universal condition is the large number of men who have launched out as master steam fitters without other capital than their mechanical knowledge, with no previous business training, and who are satisfied to make ordinary workman's wages while the profit is divided between the consumer and the supply house.

"And the number of such 'masters' is continually increasing. I have been frequently asked by men who have faced these conditions a few years and whose financial strength has been slowly but steadily depleted by them, 'is there no possible way to stop this thing?' I must confess that the problem is beyond my power to solve. It is impossible to prevent any man from embarking in an independent business if he chooses to do so. It has been said that nine-tenths of these men would not undertake it if the supply houses did not back them up and practically supply the requisite capi-

tal, in most cases getting the pledge of the owner for payment of the materials and frequently supplying the engineering skill required to make the layout. This is the second problem, and I am unable to solve it. We cannot expect to influence or control the business methods of the supply houses in a thousand places, whose business extends only a few miles from the cities in which they are located.

"It may be said that these conditions can be overcome by the local master steam fitters refusing to patronize the supply houses that use such methods. In many places this has been tried with greater or less effect, according to the value set upon the patronage of such master steam fitters by the supply houses concerned. Moreover, this remedy, wherever used, must be supplied without definite concerted action, to avoid the charge of illegal combination. And yet I submit to you it is as wrong morally for the supply houses and the mechanic to make a condition that is ruinous to the business of the master steam fitters as it would be for the master steam fitters to make such combinations as would rob the consumer of exorbitant prices.

"I have hesitated to bring this subject to your attention because I cannot at this time suggest a specific remedy for the trouble, but the condition is so bad and so universal that it should receive our careful consideration in the hope that, by our united effort, we may find some way to at least mitigate, if we cannot cure it.

"As suggestions for use in the discussion of these kindred subjects, I would mention the fact that wherever this condition has been partially overcome, either all the men in our business or a large percentage of them are associated for their mutual benefit, such associations being the basis for friendly relationship and frequent intercourse between them. In this way they are able to educate the more ignorant members.

PROPOSES ELIMINATION OF LABOR FROM BUSINESS

"I have thought at times that a solution of these problems may be found in the practical elimination of labor from our business, in each master fitter, or such consolidations as may be necessary, doing a retail supply and engineering business and allowing the owner to deal direct with the workmen and thus relieve us of the most unprofitable part of our business and the part that gives us most trouble. This seems at first a radical and impracticable remedy, but it is worth our careful consideration."

Following the president's address, a notable tribute was paid to Alfred E. Kenrick, of Brookline, Mass., in recognition of the fact that he is not only a charter member of the association, but has attended every annual convention from the first one, held in Chicago in 1889, up to date. During that time he has served as treasurer, then as president and for ten consecutive years as a member of the Board of Directors.

On motion of William H. Oakes, of Boston, a resolution, handsomely engrossed, calling attention to Mr. Kenrick's services and voicing the appreciation of the association, was presented to him, together with a more substantial token consisting of a large silver pitcher and tray, suitably inscribed. Mr. Kenrick was escorted to the platform by Elias D. Smith and John T. Bradley and found words to express his acknowledgments, stating that he little dreamed when he attended the first convention that he would be considered twenty-five years later to merit such a tribute from the association.

Another presentation made at this session was that of an ivory gavel and block made by W. G. Le Compte on behalf of Jenkins Bros., of New York.

The convention then went into executive session, when reports were presented from the other officers and from the Board of Directors. The treasurer's report, submitted by J. A. Almirall, showed cash on hand May 1, 1912, $9,041.19; receipts, May 1, 1912, to May 1, 1913, $17,252.79, making a total of $26,293.98. The expenses for the year were $17,515.83, leaving a cash balance of $8,778.15.

The report of the secretary, H. B. Gombers, showed that in 1911-1912 122 new members were added to the roll and 41 dropped. During the past fiscal year 261 new names have been added and 50

dropped. During the year thousands of copies of the "1912 U. S. Standard" Schedule of flanged fittings and flanges have been distributed by the societies and associations interested.

Tuesday evening interesting addresses were made on the subject of boilers and heat generation, with particular reference to their own products, by J. A. Waddell, of the Spencer Heater Co., Scranton, Pa., and by H. R. Dillon, of the American Radiator Co. Mr. Dillon's address was illustrated by lantern slides and proved of as much interest to the ladies and other guests as to the members.

At the open session Wednesday afternoon officers for the ensuing year were elected as follows:

NEW OFFICERS

President, Edward B. Denny, Newark, N. J.

First vice-president, John T. Bradley, St. Louis, Mo.

Second vice-president, Samuel Wright, Buffalo, N. Y.

Third vice-president, Frank G. Carthey, Salt Lake City, Utah.

Treasurer, J. A. Almirall, New York.

Directors: Edward B. Denny, Newark, N. J.; John T. Bradley, St. Louis, Mo.; Samuel Wright, Buffalo, N. Y.; Frank G. Carthey, Salt Lake City; J. A. Almirall, New York; William H. Oakes, Boston; P. F. Maginn, Pittsburgh; Edward Grassler, Milwaukee, and Charles A. Geoghegan, New York.

In accepting the office of president for the third consecutive term, Mr. Denny stated that the breaking of precedents in this connection was due to the fact that the work undertaken by the present administration was but partially completed, so that he had consented to serve once more in order to finish the plans that had been launched.

A vote of thanks was tendered F. W. Oliver, of Niagara Falls, for the loan of his certificate of membership, which was on exhibition during the convention. This certificate, issued in 1890, is considered the oldest of its kind extant. Votes of thanks were also extended to the association's conference committee, trade relations committee, standardization committee, and to the Spencer Heater Company and the American Radiator Company for the addresses given under their auspices on the subject of boilers.

This practically ended the business of the convention, although a short session was held Thursday morning to finish up minor details.

The Entertainment

At the organization meeting of the Manufacturers Entertainment Committee, Chairman W. G. LeCompte presiding J. Barton Garfield was appointed temporary secretary-treasurer and committees were appointed as follows: For ladies' automobile ride, George G. Schmidt and H. P. Mishler; captain of rifle team, A. H. Probst; captain of bowling team, E. C. Molby; bowling committee, Homer Addams, chairman, and Messrs. J. Barton Garfield and H. J. Issertell; committee for Gorge trolley ride, H. J. Issertell, H. C. Webster and E. F. Glore.

Chairman W. G. LeCompte was re-elected and J. Barton Garfield was elected secretary-treasurer.

The following firms subscribed to the entertainment fund:

SUBSCRIBERS TO ENTERTAINMENT FUND.

Bishop-Babcock-Becker Co., Cleveland, O.
Richmond Radiator Co., New York.
H. B. Smith Co., Westfield, Mass.
Kewanee Boiler Co., Kewanee, Ill.
Jas. A. Donnelly, New York.
H. W. Johns-Manville Co., New York.
Richardson & Boynton Co., New York.
United States Radiator Corporation, Detroit, Mich.
Pierce, Butler & Pierce Mfg. Co., Syracuse, N. Y.
American Radiator Co., Chicago.
Jenkins Bros., New York.
Sprague Electric Works, New York.
Keasbey & Mattison Co., New York.
Consolidated Engineering Co., Chicago.
Boynton Furnace Co., New York.
Fowler & Wolfe Mfg. Co., Philadelphia, Pa.
General Fire Extinguisher Co., Providence, R. I.
Warren Webster & Co., Camden, N. J.
Standard Steam Specialty Co., New York.
C. A. Dunham Co., Marshalltown, Ia.
G. G. Schmidt, New York.
Kanawha Mine Car Co., Charleston, W. Va.
Spencer Heater Co., Scranton, Pa.

On Tuesday afternoon the ladies were taken in automobiles for a ride around Goat Island, alighting at intervals to view the

Falls and upper rapids. On the way back the route lay through the government reservation and past the residential section of Niagara Falls.

As in former years, the principal social event of the convention was the bowling tournament Wednesday night, June 25, at Schwarz's alleys. This included a team match between the supply men and master fitters and a special tournament for the ladies.

Immediately following the tournament the contestants, members and guests, returned to the International Hotel, where a luncheon was served and the prizes awarded. The party broke up at a late hour, after pronouncing the occasion an entire success and well worthy of comparison with past traditions in this direction.

The principal outing of the convention was on Thursday, when specially chartered trolley cars took the convention party through the Gorge, thence across the river at Lewiston, up past the Whirlpool to the Horseshoe Falls, where the party alighted to get a close view of the waters. On the return trip covering the same ground, a stop was made at the Brock monument on the Canadian side, where a distant view was had of Lake Ontario.

This marked the close of the convention.

The Exhibitors.

Consolidated Engineering Co., Chicago, had a striking exhibit of the Van Auken system of vacuum heating and the Thermograde modulation system of heating, including also a full line of the Van Auken steam specialties. A special feature of the exhibit was a new type of electric boiler feed pump which attracted much attention. The display was in charge of A. H. Probst, the company's inspector and expert. Others present in the interests of the company were B. E. Van Auken, president; R. W. Hillman and William J. Price.

Bishop-Babcock-Becker Co., Cleveland O., showed its electric and hydraulic vacuum pump air line and return line heating systems. H. P. Mishler, of the company's home office, was in charge.

Halsey Thermostat Heat Regulator Co., Philadelphia, Pa., had a working model of its thermostatic heat regulator, which was shown in operation by W. W. Hoyle, sales manager and distributor. The exhibit also included the Halsey everlasting self-adjusting thermo valve. Irving S. Dane was also present from the company's factory in Lynn, Mass.

Harrington Mfg. Co., Boston, Mass., showed its new adjustable dies for pipe threading work, cutting both right and left hand threads with the same die. Benjamin F. Earl, sales manager, was in charge of the exhibit.

General Fire Extinguisher Co., Providence, R. I., was represented by Thos. M. Mayer, who had on view types of the Patterson-Allen cold extrusion flange joints, which are now being marketed by this company.

Fairbanks Pipe Wrench was displayed by Fuller Bros. & Co., New York, the sample wrench being accompanied by circular matter detailing its design and construction and including price lists carrying sizes from 6 in. to 48 in., capable of taking pipe from ½-in. to 5-in. in diameter.

Fowler & Wolfe Suspension Wall Brackets formed an interesting exhibit, being designed as supports for wall radiators. Attention was called to the fact that the bracket may be attached to brick, concrete, or any wall or surface, and that it holds the radidator securely, at the same time providing for expansion and contraction. It is also adjustable before or after the radidator is in place, the range being 3 in. up or down. It is described as the most efficient support ever devised for long and heavy radiators. It is anchored to the wall by expansion bolts or screws. R. C. Bolsinger was on hand in the interests of the company.

Positive Differential System Co., New York, distributed circulars describing its gravity and vacuum return line systems. The company was represented by James A. Donnelly, president and general manager, and George G. Schmidt.

A. M. Byers Co., Pittsburgh, distributed copies of its pamphlet on "The Control of Quality in Every Process," showing the vital importance of right methods in the manufacture of wrought iron pipe and how these are applied by the company which manufacture Byers' wrought iron pipe.

Bernhard Water Tube Boilers, the latest invention of J. B. Bernhard, who has been for twenty years a well-known figure in the boiler trade, came in for much comment through the exhibit of a sample boiler completely set up and practically ready for operation. This new line of boilers is being manufactured by the Kanawha Mine Car Co., Charleston, W. Va., whose long and successful experience in the manufacture of cast iron products, coupled with Mr. Bernhard's practical experience in this particular branch of business was taken as an assurance of the success of this new line. The boiler is of the side-feed type, its low elevation being emphasized as avoiding the necessity for digging a boiler pit. Another feature is that it requires but 15 hollow or cored castings for the entire line, a notable

reduction from the number ordinarily required, running up to 100 and over. Its B.T.U. ratings which are listed in the company's printed matter, are guaranteed. Mr. Bernhard, who was on hand to explain the features of this new boiler, was warmly congratulated on his design by his many friends in the trade.

Cinch Expansion Bolts, forming what was described as a perfect conical truss, in which the anchorage was stronger than the bolt, was the subject of circular matter distributed by the Cinch Expansion Bolt and Engineering Co., of New York, through William F. Devenport, special agent, Rochester, N. Y.

C. A. Dunham Co., Marshalltown, Ia., distributed souvenirs that were much in demand, consisting of solid brass paper clips, incidentally featuring the Hunham system of vacuum heating. J. J. McKee represented the company at the convention.

Warren Webster & Co., Camden, N. J., had a unique exhibit in the shape of a large electrically-illuminated dial whose pointer was connected to a sylphon bellows, such as is used in the Webster modulation valves, and alternately immersed in hot water and exposed to the air. The movement of the pointer showed the quick response of the bellows to heat and cold. Those present for the company were John F. Hale, general manager; E. K. Webster, E. H. Newman and L. H. Quackenboss.

Iowa State Association.

Iowa Master Steam and Hot Water Fitters' Association held its first convention in Des Moines, May 20, State Chairman John F. Garvey presiding. Permanent organization was effected by the election of the following officers: President, John F. Garvey, Mason City; vice-president, Mr. Wilson, Washington; treasurer, E. S. Betsworth, Cherokee; secretary, R. Knauer, Des Moines.

New Jersey State Association.

At the eighth annual meeting of the New Jersey State Association of Master Steam and Hot Water Fitters, the following officers were elected: President, Thomas B. Cryer, Newark; vice-president, Joel S. Bryce, Asbury Park; treasurer, Harry Geiser, Newark; board of directors (for three years): Edward B. Denny, Newark, and David H. Moore, Atlantic City; sergeant-at-arms, George F. Kappel, Camden.

New York State Association.

Officers were elected as follows at the nineteenth annual convention of the Master Steam and Hot Water Fitters of the State of New York, held at Syracuse, May 13: President, William H. Curtin, Brooklyn; vice-president, Frank Leavery, Syracuse; secretary-treasurer, William H. McKiever, New York; board of directors: Samuel Wright, Buffalo; Edward F. Joy, Syracuse; William J. Olvany, New York; Edward Towe, Rochester; N. Loring Danforth, Buffalo; sergeant-at-arms, William Scollay, Brooklyn; recording secretary, H. B. Gombers. Following the convention the visiting members were entertained at dinner at the Hotel Onondaga.

National Association of Master Plumbers.

A record attendance of 1,500 delegates and guests was registered at the thirty-first annual convention of the National Association of Master Plumbers, held in Philadelphia, June 16-20. The new officers are: President, Chris. Irving, Denver, Colo.; vice-president, S. Louis Barnes; treasurer, William McCoach, Philadelphia. President Irving's appointment of Archie J. Davis, of Denver, as secretary, was confirmed by the convention.

It was voted to hold the 1914 convention at Atlantic City, N. J.

A Convention of the Trade Press.

Probably the most notable gathering of technical, class and trade journal editors and publishers ever assembled in America, will meet in New York, September 18-20, 1913, when the Federation of Trade Press Associations in the United States holds its eighth annual convention. With business promotion through trade press efficiency as its keynote the convention will be one that will present matters of importance to business and professional men, as well as to editors, publishers and advertisers.

Headquarters will be at the Hotel Astor, where two sessions will be held daily. Some idea of the scope of the convention may be gained from the fact that the programme will include symposiums on editorial work, circulation and advertising, each symposium comprising a dozen or more papers on various phases of the subject. At one of the sessions a demonstration will be made on "How to Sell Advertising Space in a Trade Paper." William H. Ukers, of the Tea and Coffee Trade Journal, 79 Wall St., New York, is chairman of the committee of arrangements.

THE HEATING AND VENTILATING MAGAZINE

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THERE IS a note of prophecy in the proposition recently put forward by an interested group of New York people and termed by them an "efficiency living plan." In its development, the plan would directly affect many who furnish mechanical equipment for buildings. The idea is to work out the physical need-providing part of life in such a way as to take even less time and money that has been the result of evolution to date. In addition, social and educational life is included in the plan, to be conducted in such a way as to make for the greatest individual, family and community development.

With regard to its mechanical features, the scheme is to group family houses around a central plant in which will take place all the activities now carried on in separate homes, but which, it is thought, can be conducted more economically in the central plant, without loss of any other kind. This will include, in varying degree, some or all of the following items: Heating, eating, washing, cleaning, repairing, storing and clothing (sewing). An expert opinion on the heating problem is responsible for the statement that from 20 to 25 families are the smallest unit for maximum economy on that score.

Thoughtful people have recognized for some time that the waste consequent upon the operation of individual mechanical plants, especially small units, is on the increase, and, while the proposition here outlined has been adopted to some extent with varying degrees of success, it is more than probable that future installations will show greater economy as the number of labor-saving devices continues to multiply.

FURTHER importance to the commission which will study ventilation under the bequest of Mrs. Elizabeth M. Anderson has been extended to it through the action of Governor Sulzer of New York in making it a State commission. This will not only serve to enhance its prestige in obtaining useful data, but will give its findings an added authority. The Association for Improving the Condition of the Poor, under whose auspices the commission is working, is interested particularly in school-room conditions, and co-operation has already been assured between the commission and the New York City Department of Education. It may be said that no definite outline of the investigation has been made as yet, the commission preferring to follow the leads which, it is anticipated, will be disclosed by the experiments themselves.

AS in former years, the weather records for the heating season in five representative American cities will be omitted during the summer months. Their publication will be resumed next winter. The charts as published in this magazine now form a continuous record dating from 1906.

THE CONSULTING ENGINEER

"The Consulting Engineer" is prepared to reply, in this department, to any questions which our readers may ask regarding problems connected with the design and installation of mechanical equipments of buildings.

18—How to Figure Boiler Horse Power.

QUESTION: The following calculations were made to determine the boiler horse power required to heat a certain building with (first) steam heat and (second) hot water by forced circulation. The building in question requires 15,400 sq. ft. of direct radiation which is figured for steam at 212° F. and which is sufficient for one change of air per hour.

There is also a total of 5,794 sq. ft. of indirect radiation figured for steam, to be used in the ventilating system. The fresh air supplied is 65,000 cu. ft. per minute, measured at 70° F., and represents about three changes of air per hour in the heated areas. The air is figured to enter coils at 40° F. and to leave same at 70° F., with allowance for a 10° cooling action by air washers.

The calculations made are as follows and are based on the assumption that the same degree of heat would be available with either steam or hot water, viz., 212° F., the boilers in either case to generate steam.

STEAM HEATING.

Direct radiation, 15,400 sq. ft. x 0.33 =	5,082
Indirect radiation, 5,794 sq. ft. surface:	
Reheater, 2,340 x 1.54 cond. . . . . =	3,603
Tempering, 3,454 x 2.08 cond. . . . =	7,174
	15,859
10% allowance for line and station loss . . . . . =	1,585
Pounds of total steam required per hour . . . . . =	17,444
Boiler horse power, 17,444 ÷ 34. . . . =	512

HOT WATER HEATING.

Sq. ft. direct radiation. . . . . =	15,400
Sq. ft. indirect radiation. . . . . =	5,794
Sq. ft. equivalent total direct radiation . . . . . =	44,200
B. T. U. per square foot per hour =	180
Percentage allowance for line and other losses . . . . . =	10

One boiler horse power equals 34 x 970 = 33,000 B. T. U. per hour.

Boiler horse power required for hot water equals

$$\frac{44{,}200 \times (180 + 10)}{33{,}000} = 254.$$

The writer would deem it a great favor if you would criticize the calculations through your queries and answers column, and if you consider them wrong kindly give the correct method of determining the boiler horse power for these two systems.

Answer: The mistake made in both calculations is a common one, that is, using the square feet of radiation or its equivalent in condensate for the basis of figuring the boiler horsepower, instead of the data in B.T.U. from which the radiation was originally calculated.

The amount of steam that the radiators will condense under maximum conditions is no criterion that this amount will be required. Generally, an excess of radiation is added, for one reason or another, in apportioning it and the 0.3 lbs. per square foot might be all out of proportion.

In heating air, the B. T. U. will be the number necessary to raise the quantity through the range required, regardless of whether the indirect stack is too large or too small. If the B.T.U. for the building have been totaled to proportion the direct surface, it will be nearer the boiler power required and eliminates any error of radiation, piping or equipment. The direct radiation does not vary as much as indirect in condensation, and assuming a condensation rate per square foot is almost sure to lead to error.

Figuring backward to find what temperature the room will have to be to produce 0.3 lbs. per square foot with 212° F. in the radiator, the result will be as follows:

Let x be the temperature of the room.

0.3 lbs. × 1000 B.T.U. (approx. latent heat in 1 lb. of steam) = 300 B.T.U.

Let 1.8 B.T.U. be the transmission per degree difference per square foot per hour.

Then $(212 - x)\ 1.8 = 300.$

$$x = 212 - \frac{300}{1.8} = 46°$$

This requires a room temperature of 46° F. to produce this rate of condensation and might be allowable for intermittent heating, but is unnecessary when boiler power in addition has to be provided to

heat outdoor air, as the fan may be shut down and the pressure raised on the direct radiation.

180 B.T.U. was arbitrarily used in the water for the same temperature conditions which gives 0.18 lbs. of condensate per square foot, or a little over one-half. If the direct radiation is taken as just sufficient to counteract the loss through the walls and glass and 70° F. is the room temperature, we have:

$$\frac{(212-70)\times 1.8}{1000} = 0.2556 \text{ lbs. per square foot or 256 B.T.U.}$$

If the room is 60° F., the radiation would be less and the condensation raised as follows:

$$\frac{(212-60)\times 1.8}{1000} = 0.2736, \text{ or } 274 \text{ B.T.U. per hour.}$$

This shows the variety of results that can be obtained by varying conditions and the liability of error where a flat rate for condensation is taken.

In determining the boiler power for the air, the amount of heat required should be taken independent of fan, stack or ducts, as any of the three may be in error, making too much or too little boiler power. If the air is raised from 0° F. to 70° F., it will require for 70° raise and 65,000 sq. ft. as follows:

Weight of dry air per cubic foot, 0.075 lbs., specified heat, 0.24.

Then $65{,}000\times 0.075\times 0.24\times 60$ (min.) = 4,914,000 B.T.U. per hour.

15,400 (sq. ft. direct radiation) × 260 B.T.U. ....= 4,004,000 B.T.U. per hour

Total 8,918,000

8,918,000 ÷ 33,000=270 boiler horse power.

300 boiler horse power should be provided at 10 to 15 sq. ft. of surface per hour per horse power, independent on how the job is to be operated and type of boilers. It will readily be seen that from this manner of calculation, both steam and water will give the same results, as they should.

In case the air is humidified, the amount of water evaporated should be taken into account, with the latent heat necessary to vaporize it. This will be a maximum in extreme weather, as the power to absorb moisture at lower temperature is light. If 60° F. wet bulb is desired, or 70° and 60% humidity, 4.5 grains about will have to be introduced per cubic foot and evaporated when the air is at zero outside.

$$\frac{65{,}000 \times 4.5 \text{ grains} \times 60 \text{ min.}}{7000 \text{ grains to pound}} = 2507 \text{ lbs. moisture per hour.}$$

The water will have to be raised from feed temperature, say, 40° F. and the latent heat at 60° F. is about 1050 B.T.U. per pound and the total heat will be 1050 + (60 — 40) = 1070 B.T.U. per pound.

2507 lbs. × 1070 B.T.U. = 2,682,490 B.T.U. per hour. Adding this to 8,918,000 will give 11,600,490 B.T.U. or 351 H.P.

351 H.P. for maximum requirements will give ample boiler capacity to spare for all moderate weather, as the ventilation may be reduced or the humidity reduced during the 1% or 2% of extreme weather, or the boilers could be forced for this short period. The average load will be about 50% of this or about 170 H.P., if hot water is used, varying the temperature or through automatic heat control, if same is provided for the steam.

The writer has figured the humididty requirements for different outside conditions. The maximum load will be one-third to one-sixth in very moderate weather and about one-half in average winter weather or 80 H.P., 40 H.P., and 25 to 30 H.P., in very moderate weather. If a lower temperature of air is used with the humidifying apparatus, say 5° lower, the horsepower for the heating would be reduced to about 240 H.P.

As a rule, in figuring the steam for air supply, 55,000 cu. ft. of air will require 1 lb. of steam per degree.

$55{,}000\times 0.075\times 0.24 = 990$ B.T.U., or the latent heat in 1 lb. of steam. The above figures are intended to give methods, and by changing the conditions the proper result can be readily obtained.

It is better practice to figure quantities exact and add whatever is necessary for a factor of safety to the final result, rather than to the individual quantities that make up the total, as the liability of error is less and the addition can be made with better judgment, possibly decreasing the cost of the plant.

Appraisal of Heating Properties

Companies operating central station heating plants are coming under the jurisdiction of public utility commissions to an extent that is only beginning to be appreciated by owners and operators. There is scarcely a State now that does not boast of its public utility commission and, in many cases, the laws under which they act give them the power of life and death over the companies in fixing the rates at which heat shall be sold.

In this connection, a speaker at the recent convention of the National District Heating Association, Harold Almert, of H. M. Byllesby & Co., of Chicago, presented a paper in which he stated that, with this

commission control, an imperative need has arisen for accurate and comprehensive appraisals of the entire property of public service corporations, because this is the basis on which the rates to be charged by the companies are being based.

"The mere enumeration and pricing of such items of physical property as are visible," said Mr. Almert, "is a simple task which can be performed by almost any engineer to the entire satisfaction of all concerned; but to make a complete and comprehensive appraisal of every item, both tangible and intangible, which should properly be considered in making up a value on which the utility is entitled to earn a fair return is an entirely different matter, and calls for experience and training, both technical and commercial, of a very high order, and has opened up a new field of usefulness for engineers of ability and integrity in the preparation of cases for hearing before regulating bodies.

"The company which I represent are owners and operators of public utilities, as well as engineers. Until recently it was our standard practice to make a careful detailed appraisal of every property soon after its acquirement—this appraisal being corrected every month, so that it was always up to date. We felt, therefore, that we were in an excellent position to meet any kind of an investigation which might come up, but in this we have been disappointed. We have learned that where the valuations are made by ourselves, they do not carry the weight with the commissions that they do when made by a disinterested firm of engineers of recognized standing. We have, therefore, modified our practice, so that now the valuations of our own properties are made by others."

Mr. Almert gave some details of the vast amount of legislation passed in all parts of the country calling for the inquiry into, or the restriction of, profits earned by public service corporations. In many cases the legislators themselves know little or nothing about the subject and not infrequently the personnel of the commissions, while including men of known honesty and character, has been such that the commissions have not had the faintest conception of the obligations or rights of the utilities which they were called upon to regulate. For this reason it is becoming the practice for the commissions to surround themselves with a corps of engineers, accountants, attorneys and statisticians, whose duty it is to gather data and information regarding conditions which the commissioners then proceed to absorb.

In making a valuation, the speaker referred to the difficulty of ascertaining the item variously styled as "going value," "going concern value," etc. He advised all central station heating companies, however, to fully analyze their own situation, to find out in detail the exact investment which they have for any given class of consumers, the exact cost of serving them, the revenue received, and after deducting all proper charges for operation, taxes, maintenance, depreciation, etc., whether or not they have sufficient left over to pay a reasonable return. "A careful analysis of this kind," he said, "may show surprising results."

"You may find," he said, "that a class of business which you supposed was most profitable is not. Again, it may show that you can afford to reduce your rates to another class, thereby making it possible to materially increase the number of that class of customers, and while you decrease the net per unit your total net will be increased and the business as a whole will be more profitable."

"Comparatively few companies," he concluded, "have the facilities, time or talent within their own organization to make such analyses quickly and correctly, but you can buy services of this character in the open market. So fortify yourselves, and when the council, commission or other inquisitorial body knocks at your door, you will have at hand facts—real, indisputable facts, and to get them be careful in the selection of your experts. Don't select one who will simply give you an array of figures that look well on paper but prove nothing. Remember that commissions have a right to administer oaths and put you or any one else in your organization on the witness stand to get at the real facts, and generally do so; and also have a right to go into all of your books and records and see for themselves if your evidence looks misleading. And if they find that you expert's figures are not facts, you have probably done your case more harm than good by submitting them."

"Overhead Charges" and "The Business Known as Plumbing" are titles of two pamphlets which have been prepared for general distribution as the result of a joint conference between committees representing the National Association of Master Steam and Hot Water Fitters and the National Association of Master Plumbers. The pamphlets are supplemented by a poster, entitled "How to Make a Profit," the whole being intended for the guidance of master fitters and master plumbers in calculating their overhead charges and the cost of doing business.

An Efficiency Living Plan.

A plan to work out the physical need-providing part of life in such a way as to take even less time and money than at present and to supplement this with individual, family and community development, is being drawn up by a group of people in New York City. In a general way the plan is to group family houses around a central plant in which will take place all the activities now carried on in separate homes but which, without loss of any other kind, can be carried on more economically in a central plant.

This will include, in varying degree, some or all of the following items:

Physical requirements—Heating, eating, washing, cleaning, repairing, storing and clothing (sewing).

An engineer has been consulted for the heating problem and it has been learned that from 20 to 25 families would be the smallest unit for maximum economy on that score. For the other points, a fund of information could be turned over to an architect with instructions to make a preliminary design and an estimate of cost of construction and maintenance.

If such plans should show a considerable saving they can be further worked out with reference to points connected with social and educational needs, such as children's nursery and playground, assembly rooms and stage, gymnasium and baths, etc.

The headquarters of the committee which is at work on the plan are at 922 Madison Avenue, New York, Mary B. Erty, secretary.

Present Practice in Insulating Underground Steam Lines.

In preparing a paper on "The Insulation of Underground Steam Lines," for presentation before the National District Heating Association, H. W. Prentis, Jr., of the Armstrong Cork Co., Pittsburgh, sent a question blank to every active member of the association, asking, among other questions, the following:

"What is your standard method of insulating underground steam lines? Are you entirely satisfied with it? If not, what are your chief objections? Have you ever tried other methods? If so, describe them and state what led you to discard them?"

Almost 70 replies were received, which, when tabulated, yielded the following interesting data:

Forty-six replied that they were using, or had used wood casing. Twenty-nine stated that they considered this form of insulation entirely satisfactory—while seventeen had one objection or another to offer. Nine, for instance, claimed that it was impossible to keep the casing watertight, and that it was subject, therefore, to rapid decay. Three stated that they had had trouble with charring; two said they found it difficult to install; and two others complained that it was hard to repair. Many in their replies emphasized the fact that this form of insulation—or for that matter, any form, must be so installed as to provide for the proper under-drainage.

Seven concerns reported that they used wood boxes waterproofed with tar or pitch and filled with sawdust or shavings. Five of these had hot water—not steam systems. All but one stated, however, that this form of insulation was unsatisfactory, the chief objection being that it deteriorated rapidly.

Four plants use wood boxes protected with tar paper, the piping being insulated with sectional coverings and packed all around with shavings or some other loose filling. This construction was said to be expensive and not very durable.

Seven plants reported that they were using tunnels—either wholly or in part—with the pipes insulated with some form of sectional covering. Without exception they stated that the cost was high. One report from a concern in Montana was particularly interesting. Some of its tunnels are from 20 to 30 ft. underground, all being graded so as to return the condensation. This is extremely important, as their water costs them 18c. per thousand gallons and they have 10,000 ft. of line in use. In 1912 the condensation returned actually paid 7¾% on their entire tunnel investment.

Six plants replied that they were using split tile with some form of sectional covering—four with entire satisfaction, while one suspected that their particular form of construction was not as efficient as it should be and another complained that the drainage water got into the tile, causing trouble.

Only one plant using split tile with loose insulating filling. This method was condemned because seepage water got into the tile and melted down the filling, leaving the main exposed.

But one concern, moreover, reported using boxes constructed of partition tile. This was giving satisfactory results, but the owner added the usual caution that all such construction must be arranged so that it will drain properly.

One concern—The Pacific Gas & Electric Company, of San Francisco, stated that they had 55,000 ft. of main sulated with an air space and a tin-lined layer of wool felt, the whole being surrounded by an outer

casing of concrete 2½-in. thick, the concrete being reinforced with wire netting. This was reported quite satisfactory—the cost being given as 90 cents per lineal foot for 3-in. pipe and $1.25 for 6-in. pipe—not including the cost of the pipe itself and the trench work.

Another concern reported that they had some 12,000 ft. of main laid in wooden boxes and packed around with shavings, the whole then being encased in a solid concrete envelope.

Effects of Back Drafts in Dusty Ventilating Ducts.

Discussing the use of the open window, J. F. Goodchild, writing in "The Public Health Journal," relates that when the convalescent Home for Children, in England, was built, an elaborate system of heating and ventilation was introduced of a type familiar in hospitals and public institutions generally. The idea was to warm the air by bringing it in from the outside over numerous radiators and to extract it by horizontal air ducts in the ceilings of the rooms, these ducts communicating at each end of the building with tall ventilating upcast airshafts.

The ventilation did not prove satisfactory and among other evidences of its defective nature, was the occurrence of small epidemics of sore throat. It was established that the sore throats very often did not spread from person to person, but broke out in different wards whose inmates had not been in contact. Attention was first directed to the radiators, and it was found that they very soon become covered with dust brought in by the incoming air. And, as is the case in so many other establishments, some of these radiators were fixed in positions which made it impossible to clean them efficiently, or their design was such that it was impossible to get brushes between the heating tubes.

The institution management came to the conclusion that a good radiator should be of such a design and so placed that it could be cleaned and dusted daily with facility and, further, that it should consist of polished tubes rendering any deposit of dust easily visible and so stimulate servants, if they took pride in their work, to keep the polished surface in a more creditable condition.

Instead of introducing new radiators, however, the inlets were closed so that the stream of dust-laden air no longer passed over them. Attention was then turned to the extraction system, and it was found that the difference of temperature between the air in the ducts and that outside the building was so small that the current was sluggish and, consequently, easily reversed.

An engineer showed by experiment that wind striking the building on one side had a tendency to increase the pressure of air in the rooms on that side and to diminish the pressure in the rooms on the opposite side, with the result that in these latter rooms there was a tendency for the system of ventilation to be upset, causing the passages intended as upcasts to act as downcasts.

It was found that when there was no wind the ventilation acted perfectly and as was intended, but even when a slight wind arose the air instead of passing away through the extraction passages was drawn down, owing to the reduced air pressure in the rooms on the side of the building opposite to the direction in which the wind was blowing. The air ducts and shafts could not be cleaned and were known to be full of dust, which was suspected to be full of objectionable organisms. Under the supervision of the Broadstairs Health Officer the following bacteriological experiments were carried out:

AIR FROM VENT DUCTS FILLED WITH BACTERIA.

Two plates were exposed five minutes beneath the airshafts in the ceiling in one of the wards, the medium on the one being placed so that it looked upwards towards the opening, and the medium on the other so that it looked downwards toward the floor. Plates were also exposed within the airshafts and on the beds in the wards.

In the plate within the airshaft and the plate immediately beneath it—the culture media on both of which looked upward each showed a rich growth of organisms, whereas on the plates the medium on which looked downward both were comparatively free from colonies. The plates on the beds in the wards showed only a few colonies.

Among the rich growth of organisms found on the plates about the airshafts were pathogemic varieties, including staphyococci and the micrococcus catarrhalis, whereas on the plates remote from the airshafts the pathogemic organisms were exceedingly few. The fact that the plate near the airshaft looking upwards was richly covered with organisms, whereas the plate which looked downward showed very few, proved that the air was travelling into the room through the so-called outlet, and this conclusion was confirmed by the fact that the plates inside the shaft contained the same varieties of organisms as the plate immediately beneath the opening.

The experiment was repeated in another ward after the airshaft in the ceiling had been blocked up and the plates in every instance showed only a feeble growth of micro-organisms. It was then clear that the air in the ward was a great deal purer when the so-called ventilating outlet in the ceiling was closed.

The ventilating openings in the ceilings were, accordingly, closed, the beds were removed from the side of the dormitory and placed in the centre, and all the windows were always kept slightly open, so that the ventilation of each dormitory depended entirely on the passage of air across the rooms, the air entering on the side on which the wind was blowing and finding exit on the opposite side. It was decided that this would be an efficient means of continuously changing the air.

Since these reforms there has been a very appreciable reduction in the number of sore throats and of the few cases which have occurred, practically all have been in children with adenoids and enlarged tonsils or in others who had suffered from repeated sore throats at home. One case of measles and two of chickenpox occurred, but there was no spread of the infection as had been formerly experienced.

The medical report concludes by stating that investigation shows once more that all airshafts are dangerous unless they are so big and so situated that they can be easily and regularly flushed with water. Unless this can be done the airshafts collect more and more dust and the air which passes along them into the building or room becomes increasingly dust-laden, and, therefore, microbe-laden.

Current Heating and Ventilating Literature.

Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the articles mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

ACOUSTICS—

Air Currents and Their Relation to the Acoustical Properties of Auditoriums. F. R. Watson. An account of experiments with application of the conclusions to ventilating systems. 5500 w. Eng Rec—March 8, 1913. 20c.

AIR CONDITIONS—

The Relations Between the Physical, Physiological and Psychological Aspects of Warming and Ventilation. Arthur H. Barker. Abstract of paper read before the Inst. of San. Engrs. 2500 w. Archt, Lond—April 11, 1913. Serial. 1st part. 40c.

DISTRICT HEATING—

District Heating by Steam and Hot Water. L. B. Lent. Discusses cost of the two systems and when each is preferable. Gives calculations for sizes of mains and other details. 2500 w. Power—April 29, 1913. 20c.

ELECTRICAL HEATERS—

The Construction of Electrical Heaters. H. O. Swoboda. Illustrates and describes types utilizing the four different ways of changing electricity into heat. 2500 w. Elec Jour—April, 1913. 20c.

FANS—

Facts and Theories Relating to Fans. David M. Mowat. Methods of testing exhaust fans and of calculating efficiencies. 7500 w. Col Engr—March, 1913. 40c.

Power Requirements of Fans, Blowers and Exhausters. C. W. Drake.. Gives an outline of various types of apparatus for moving air and a brief description of the characteristics, uses and limitations of each. Ills. 2500 w. Elec Jour—March, 1913. 20c.

SCHOOL HYGIENE

Hygienic Equipment of a High School. First of three articles describing heating, ventilating, air conditioning, vacuum cleaning and refrigerating systems in the West Philadelphia High School. Ills. 1800 w. Met Work—March 7, 1913. Serial. 1st part. 20c.

FAN TESTING—

Measurement of Air in Fan Work. Discussion of Charles H. Treat's paper. 1500 w. Jour Am Soc of Mech Engrs—April, 1913. 40c.

Legal Decisions

Test of Heating Capacity of Furnace.

In an action for the purchase price of a house-furnace installed in the defendant's house, the contract for the sale of the furnace, being in writing, was held to speak for itself. It described the furnace as of the size known as No. 836, and guaranteed that, with proper attention it would heat all rooms with temperature to 70° F. in the average coldest winter weather, if all outside doors and windows were properly fitted and kept closed, and provided that the buyer should have a year from the date of installation to test it. It further provided that the buyer should notify the seller at once and before the end of the year in case of the failure to heat the building and allow him a reasonable time to remedy the defect. The defenses were that the furnace was of a smaller size than that contracted for and did not heat the building to 70° F. As to

the first contention, it was held that the mere impression of the defendant that the furnace was smaller than that contracted for could not be allowed to outweigh the evidence furnished by the number on the furnace and the plaintiff's testimony that it was of the size sold.

The defendant testified that the furnace could not heat the house beyond 50° or 55° F. in cold weather. On the other hand, the plaintiff and his superintendent testified that its heating capacity was as guaranteed. After taking the testimony of these witnesses, the commissioner to whom the case was referred by the trial court made a test which showed that the heating capacity of the funrace was substantially as great as that guaranteed by the plaintiff, the temperature in the rooms ranging from 64° to 74°. This test was made in cold weather, when there was snow and ice on the ground and housetops and after the commissioner discovered and removed from the hot-air pipe from which the heat was conducted to all the rooms, a quantity of asbestos paper which had greatly obstructed it. It was held that the test thus made removed all doubt of the heating capacity of the furnace and sustained the warranty expressed in the contract.

It did not appear that the defendant had ever complained to the plaintiff that the furnace did not properly heat the house, as required in the contract, within the year. His use of the furnace for more than a year, and until after the suit was instituted, without such complaint, was held to furnish conclusive proof of acceptance of it, and that it did properly perform its work; and he was thereby estopped to deny his liability for the agreed-on price. Judgment for the plaintiff was therefore affirmed.—Weber vs. Lafe, Kentucky Court of Appeals.

CORRESPONDENCE

Energy of Air in Ventilating Flues.

EDITOR HEATING AND VENTILATING MAGAZINE:

I picked up an advertisement recently of one of the leading companies manufacturing ventilating fans, and I found the following as the heading of the advertisement:

"Less than 1% of the energy required to move a given amount of air in an ordinary ventilating flue is required to do the same work with a fan."

Such a statement is rather misleading unless a word of explanation goes with it. It is true that the total energy in the air of a ventilating flue may be greater than the work of a fan, but it absolutely cannot be utilized and should not be compared with the work of a fan. When one has a column of air in a vertical flue or in a chimney, already heated to some reasonable degree of temperature, the air will move upwards without any additional cost of energy than is already in it, but this energy is not recoverable. Consequently, it can be claimed in practice that there is no cost for moving the air in the ventilating flue, and that the air will move, up to a certain velocity, without further expenditure of energy.

If you attempt to hurry the movement of this air through a flue with a fan, the energy required for the fan goes up enormously with the increased speed of the air through the flue; in which case the user has to pay for the increased fan energy, which increases about in the ratio of the cube of the velocity.

In a case without a fan, we are utilizing something that will usually be lost, while in the case of the fan we are taking on an additional expense, which increases about as the cube, as before mentioned.

I do not wish to be understood as arguing against a fan, nor do I intend to advocate the omission of fans. On the contrary, fans are nearly always essential in ventilating apparatus, and when the flues cannot be made sufficiently large to pass the quantity of air required with the ordinary difference of temperature that may exist then we must go to fans; but the assertion that "less than 1% of the energy required to move a given amount of air in an ordinary ventilating flue is required to do the same work with a fan" is on a par with comparing the energy of a steam engine with the entire energy in the steam that operates it. One force is available, and the other is not. Such assertions are apt to lead to some confusion and waste, and the layman is led to the belief that he may use small flues and utilize fans with profit..

WILLIAM J. BALDWIN.

New York, June, 1913.

Heating Apparatus for the Froebel School, Gary, Ind.

The recently completed Froebel School, at Gary, Ind., has a typicaly up-to-date heating equipment. Fig. 1 shows the exterior of the building as it appeared last winter, while Fig. 2 shows one of the heater fans and a part of one of the tempering coils. This latter photograph was taken inside of the steel plate room which contains the fan, tempering coils and heaters.

The chamber which contains the fan and heaters is built of steel plate of No. 11 gauge, butt-jointed and riveted together

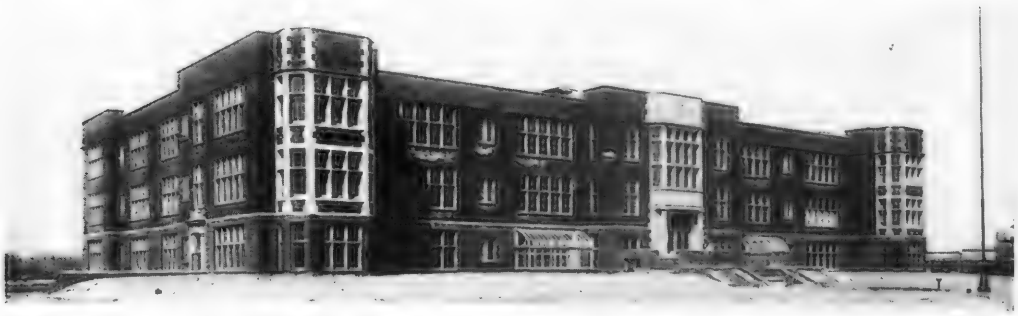


FIG. 1.—FROEBEL SCHOOL, GARY, IND.

and braced with angle irons. The motors and driving pulleys of the fans are outside of this chamber and the remainder of the heating apparatus is enclosed within it. Conveniently located steel plate doors give access to the interior of the chamber. The tempering coils and heaters are arranged with by-pass beneath them. The dampers closing the by-pass beneath the second tempering coil are shown in Fig. 2.

The heating apparatus comprises two No. 13 Sturtevant multivane fans, with tempering coils and heaters. The fans have full housings with double inlets and are double width, the wheels being supported in three ring-oiling bearings. Drive for the fans is furnished by two Sturtevant type H motors, operating at 775 R.P.M. and driving the fans by means of V belts.

Tempering coil No. 1 is built upon nine, four row, 9-ft. heater bases, each containing 146 pipes. Each of these bases has a 2½-in. steam supply and 1½-in. drip. The sections are arranged in a triple group and are raised to provide for the three by-passes beneath them. Tempering coil No. 2 is built on six.

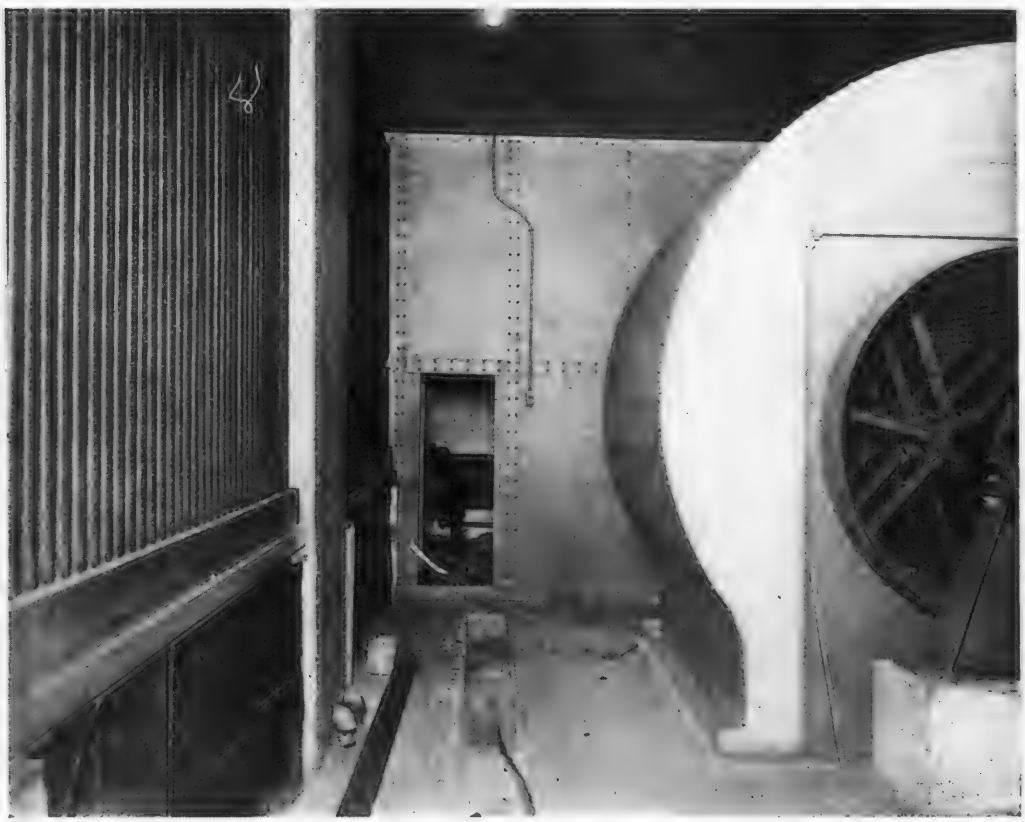


FIG. 2.—HEATER FANS AND PART OF ONE OF THE TEMPERING COILS, FROEBEL SCHOOL.

four row, 9-ft. heater bases similar to those of coil No. 2 and is arranged in the same manner. The two reheaters are each built of four, four row, 11-ft. bases, and are provided with 3-in. steam supply and 1½-in. drips.

Exhaust ventilation for the school rooms is provided by a No. 8 Sturtevant multivane exhauster, driven by a direct connected Sturtevant type C motor operating at 350 R.P.M.

The building was designed by W. B. Ittner, of St. Louis, architect, with H. H. Morrison, of St. Louis, as engineer.

Tests to be Conducted at Heating Engineers' Meeting

An interesting innovation is being prepared for the summer meeting of the American Society of Heating and Ventilating Engineers, at Buffalo, N. Y., July 17-19, 1913, when the committee on tests will conduct at the meeting tests of heating installations, appliances and equipment. The present plan is to conduct these tests at the American Radiator Company's Institute of Thermal Research in Buffalo, the facilities of which have been offered to the society for the purpose. One suggestion comprises an installation of several radiators with transparent sections in the mains to facilitate observations on the flow of steam and condensation under different conditions.

Another feature of the summer meeting will be a report of the ventilation experiments which have been conducted by Prof. Bass at the University of Minnesota with a specially constructed system in which the air supply outlets are near the pupils' heads.

Special tests will be made by the Committee on Tests on fan blast heaters, piping systems and heating boilers, and during this session L. C. Soule will present a paper on "Relative Efficiency of Pipe Coils and Cast-Iron Fan Blast Heaters," which will be supplementary to one on the same subject presented at a recent meeting of the society.

Other papers on the programme of the summer meeting are:

"Time Element in Heating Apparatus," by Ralph C. Taggart.

"Use of Charts in Determining Sizes of Pipes for Gravity Hot Water Heating," by M. S. Cooley.

"Loss of Pressure Due to Elbows in the Transmission of Air through Pipes," by Frank L. Busey.

"Experiments with Ventilation," by Prof. Frederic Bass, of the University of Minnesota.

"Cost of Plant Operation," by H. M. Hart.

"The Work of the Ventilation Department of the Bureau of Health, Chicago," by Dr. E. Vernon Hill.

The papers to be presented, together with numerous topics of discussion, will require morning and afternoon sessions July 17 and 18 and a final morning session July 19.

Summer Meeting of British Heating Engineers.

Two papers were presented at the summer meeting of the Institution of Heating and Ventilating Engineers, held at Harrogate, England, June 23-25, 1913, one on "Suggestions in Connection with the Construction of, and the Warming, Ventilating, Lighting and Water Supply Appliances for, an Operating Room for a General Hospital of 400 Beds," by Walter W. Nobbs (held over from the winter meeting), and one on "Catching Colds," by Kenneth Gray.

The outing features included a motor drive to the Fountains Abbey and Ripon and a trip to Barden Tower, thence to the Strid and afterwards to Bolton Abbey and the Stepping Stones. The general meeting was followed by a banquet at the Hotel Majestic, Harrogate.

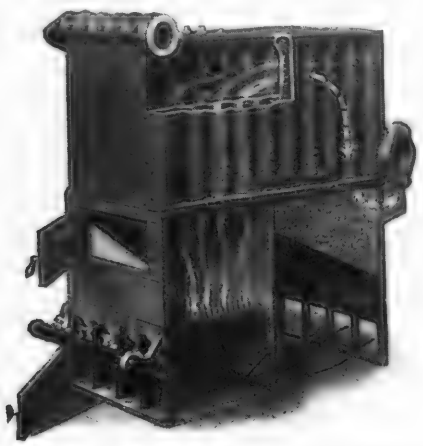
A High Efficiency Gas Boiler.

An efficiency of 92 per cent. for a hot water boiler and warm air furnace in which gas is used as the heating medium is the notable claim made for its product by the Scientific Heater Co., Cleveland, O. The company states that the scientific refinements embodied in the design of these heaters are the result of some six years of study and experimental work.

It is pointed out that in any furnace or boiler, two distinct steps must be accomplished, (1) the generation of heat from the fuel, and (2) the transmission of that heat into the circulating medium. In order to obtain the highest possible efficiency it is held that the generation of the heat from the gas must be entirely completed before any attempt is made to transmit it into the circulating medium. In this connection, the three main requirements are given as (1) the proper proportion of air and gas (2) thorough intermixture of air and gas

and (3) the maintenance of a sufficiently high temperature in the combustion chamber to make possible complete combustion. The combustion in the company's boilers and furnaces is essentially identical.

In order to assure that each individual burner may be supplied with the exact amount of air required, each burner is placed in a separate compartment, partitions being used. At the rear end of each burner



SCIENTIFIC GAS WATER HEATER.

compartment is an opening, through which the air is admitted. A gate is pivoted upon this opening and a light rod connects it with a small lever at the bottom of the gas valve, which operates that particular burner.

By this means the amount of air supplied is exactly proportional to the amount of gas used. It will be noted that if one burner should be turned on full it will obtain the full air supply; if another burner should be turned on half way it will receive just half the full amount of air. Those burners which are not turned on will receive no air.

No surplus air can pass through the boiler or furnace, absorb heat from the interior surfaces and carry same up the chimney.

The shape of the air inlet gate is such that the incoming air will be equally distributed along the burner. Each burner is "H" shaped, having two rows of Bunsen jets. A single mixer serves each burner.

In order to maintain the high temperature in the combustion chamber same is insulated on all sides, to retain the heat, and the air supplied for combustion is warmed before it comes to the burner to fully 300° to 500° F.

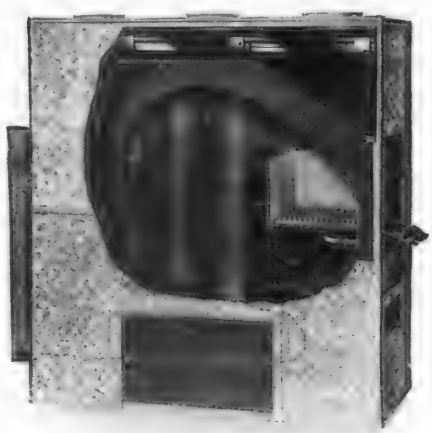
The mixer air intake is located inside of the furnace, but can be regulated from without. This system of preheating the air supply is in reality the regenerative combustion system, as used in steel producing furnaces.

In the scientific boiler the flame is not permitted to be cooled by coming in contact with any cold surface. The combustion is completed in the combustion chamber before the heat is transmitted into the water. Each burner has over thirty jets, ¼-in. in diameter, so that they cannot readily become clogged. All the burners are removable for cleaning and inspection. The burners may also be lifted out and replaced by coal grates in case of accident to the gas supply.

TRANSMISSION OF HEAT TO WATER.

The upper half of the Scientific boiler is made up of a number of hollow castings in which the water circulates, similar to a radiator. The products of combustion circulate between these castings, entering underneath the front end and leaving at the rear, as shown by the white arrows in the illustration.

The front, top and rear edges of the wa-



DETAIL SHOWING COURSE OF GASES IN SCIENTIFIC HEATER.

ter castings meet so that no gases can escape, except to the chimney. The return water enters at the rear of the boiler and zigzags toward the front, leaving at the top on each side. The circulation of the burnt gases and of the water are in opposite directions, an arrangement which is described as a very important feature of the Scientific boiler.

Just before the water leaves the boiler

it is exposed to the hot blast from the combustion chamber, and just before the exhausted gases are siphoned off to the chimney from the boiler every possible heat unit may be extracted by the cold or return water, which enters the boiler at that point.

A New Float Type Recording Differential Pressure Gauge.

An interesting float type recording differential pressure gauge has recently been perfected by Prof. William H. Bristol, who is the president and founder of The Bristol Co., Waterbury, Conn., and is being marketed by that firm. It is shown in the accompanying illustrations. The recorder was developed to meet requirements for which the spring pressure types of differential recorders are not suitable, that is for very low ranges of differential pressure in air, gases, liquids or steam, for applications where the static and differential pressures fluctuate rapidly, and also to satisfy the demand for instruments to record the rate of flow or volume directly on charts having uniform graduations in units of flow or volume.

There are two pressure chambers A and B (Fig. 2) intercommunicating through the connection C. A cylindrical float D is located in the pressure casing A as indicated, and is connected by arms to the shaft F, which extends through the casing. The recording arm G is directly connected to the end of the shaft F.

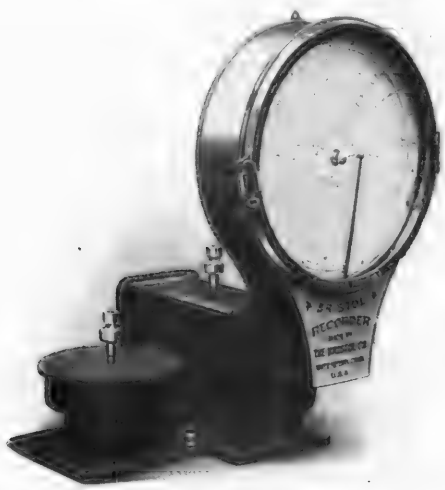


FIG. 1.—BRISTOL'S FLOAT TYPE RECORDING DIFFERENTIAL PRESSURE GAUGE.

Connections are made by means of the pipes H and I, between the pressure chambers A and B and the two pressures whose difference it is required to record. Mercury or water are employed in the pressure chambers according as the differential range to be recorded is high or low. When the higher pressure is applied to the chamber B through the pipe I, the level of the liquid in the chamber is lowered and that in the float chamber is raised, carrying the float and the attached recorder arm with it and making a record on a circular chart as it is revolved by a special clock at the desired speed.

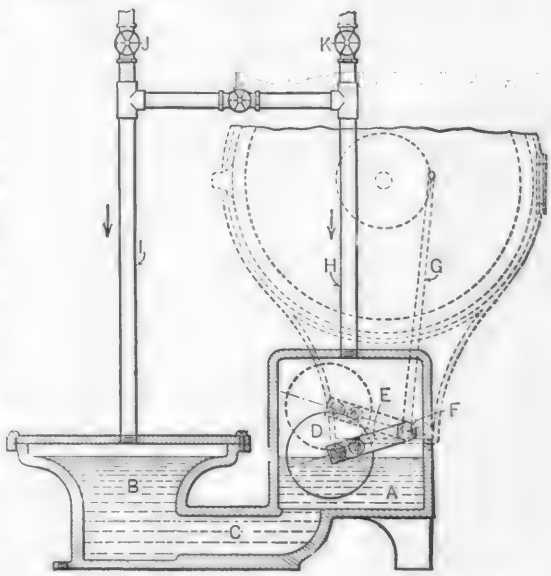


FIG. 2.—SECTION OF FLOAT TYPE RECORDING DIFFERENTIAL PRESSURE GAUGE.

By making the cross sections of the pressure chamber B of certain proportions as indicated, it is possible to produce a scale whose graduations are uniform for equal increments of flow or volume. The Bristol-Durand radii averaging instrument can therefore be used to obtain total flow or volume from the chart record of this instrument for a period of twenty-four hours.

As these gauges will operate on extremely low differential ranges they are particularly well adapted for use in connection with Pitot Tubes for recording volumes of liquids, air or gases.

This instrument may be used to record the head of water in tanks under varying pressures, as for instance, height of water in steam boilers and condensers. Another special application is that of recording the flow of water through a notch or over a wier, even though liquid is under pressure or a vacuum.

Modern Vacuum Cleaning Apparatus

The Rotrex Vacuum Cleaning System.

It is an acknowledged fact, experimentally verified, that it is impossible to entirely separate dust from air. Therefore, any system, whether it relies upon separating tanks or not, cannot prevent dust and grime from passing to the pump. Pumps with internal metallic contact, either piston or rotary, are likely to be damaged and worn by the scoring action of the dust, which, combined with the lubricating oil which such pumps require, may form in them an abrasive vitreous mass.

Since dust cannot be kept out of the pump, the latter should, if possible, be made to provide for it. Such a pump would have no internal metallic contact and would be so made as not to require oil as a lubricant. One solution of this problem is to be found in a rotary pump having a water-sealed clearance. Such a pump cannot be worn by dust and does not require oil as a lubricant. In addition, if it is combined with a submerged screen, the meshes of which are just exceeded by the pump clearance, the pump does not require any dust separation whatever. Instead, the soluble material passes into solution and is discharged from the pump direct to the sewer as a stream of discolored water, while the insoluble parts collect at the screen.

The Rotrex system employed by the Vacuum Engineering Company, 25 Madison Ave., New York City, comprises these features. The apparatus is so constructed that dust and solid matter is drawn into a submerged saturating chamber, into which, due to the vacuum, a very small flow of water is maintained. The dust passing through this water becomes dissolved; the mixture is carried through the pump and automatically discharged direct to the sewer in the form of discolored water, this cycle being clearly shown in the accompanying illustration, showing a typical installation. Broad patents cover this feature, which embodies a principle essentially different from that underlying other methods.

This company has also developed a line of tools embodying some interesting operating characteristics. For instance, difficulties in the use of vacuum cleaning tools in classrooms have recently been summarized as follows:

1. The correct manipulation is not possible within the space available.

2. Nearly 80% of the dust in classrooms occurs beneath the bench where the pupil is continually scraping his or her feet.

3. This part of the floor is acknowledged to be one of the most difficult surfaces which a vacuum cleaning tool is called upon to sweep.

4. Until now, no tool on the market was capable of sweeping these sections completely; they were simply left unswept.

In an effort to meet the difficulties here enumerated a unique tool having a modified ball and socket joint has been developed by the company, and is shown herewith. A feature of this tool is that its handle is able to assume any angle necessary beneath a bench or desk, while, through a special contrivance, the operator may rotate it on the floor at will by means of the handle without disturbing its correct position. This latter feature is obtained through the use of the studs BB.

Another tool has an unusual arrangement of its wearing felts, which form dust ducts in the sides at the three corners so that the dust travels along the side of the triangle to a corner where it meets the inrushing air and passes to the pump. This tool is especially useful in reaching corners.

A tool that prevents the surface dust from being pushed along in advance of it is also shown, and is called the Perfect bare floor sweeper. The felts have openings in front and rear, as well as narrow dust ducts to the ends. The front and rear ducts direct the dust to the central orifice, and any movement in the way of a push or pull serves for its operation. This tool is equipped with a swivel joint for the raising and lowering of the handle.

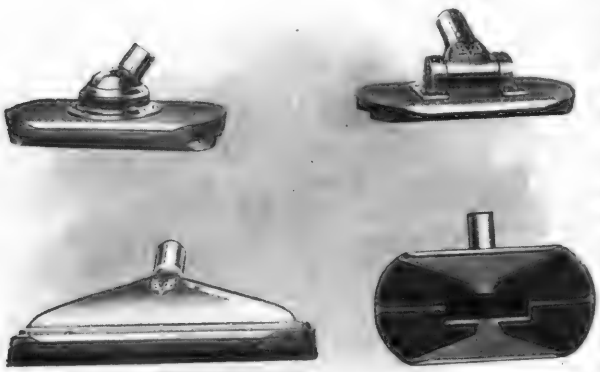
This company has also developed an interesting connection for use between the tool and handle. It consists of two split rings, the rings being split in opposite directions so that any leakage in the lower ring is baffled by the upper one. This connection is now applied to all of its tools and has been found to give no trouble through sticking, while the dimensions allow for free turning of the handle in the tool. The upper or jamb ring screws down against a square shoulder in the shank,

SECTIONAL INSTALLATION OF ROTREX STATIONARY VACUUM CLEANER.

preventing it from holding the split rings rigid.

AUXILIARY AND INCIDENTAL USES OF THIS SYSTEM.

As a means of removing water from any point of the building, in the event of the sprinkler system becoming accidentally operative, causing a flood, or in the event



NEW TYPES OF VACUUM CLEANING TOOLS.

of water from any other cause, such as leakage, causing a similar condition, and finally in case of fire, after the sprinklers have performed their function, the Rotrex system can be brought immediately into play to remove this water before it has run down to floors beneath. It can perform this service continuously, and, in addition, the apparatus is always available for this use and requires no valve or other adjustments at the machine in order to handle the water. In the event of this service being necessary, hose lines from the different outlets are concentrated to the point in question, and the water is removed and passed directly to the sewer.

The Rotrex system, by reason of its ability to handle air or water, or both, can, in the event of the failure of the sump pump, be used through its hose line to discharge this water direct to the sewer as one of its normal uses.

Its service for withdrawing obstructions in the drainage system of wash bowls, etc., by the connection thereto of a hose line, is likewise within the province of its use.

The Rotrex pump discharges all water direct to the sewer, or soil line, without any extra handling by additional pumps, and the operation of sweeping and discharging to sewer in solution is continuous and automatically performed.

Among the recent important installations awarded to the Rotrex system are the Railway Exchange Building, St. Louis, Mo., 24-sweeper plant; Hotel Biltmore, New York, 10-sweeper plant; Adams Express Company Building, New York, 12-sweeper plant.

The Challenge System of Vacuum Cleaning.

Vacuum cleaning is the modern method of removing dust and litter. It is the natural complement of our own sewage systems of garbage removal. It is the final step in sanitation and removes a class of waste matter the dangers of which have until recently been underestimated.

The Challenge vacuum cleaning system, manufactured by the Creamery Package Mfg. Co., of Chicago, Ill., has been designed with a view of providing an efficient system that shall be simple, free from complications and of extreme durability. The vacuum producer, an exterior view of which is shown in Fig. 1, consists of a centrifugal exhaust fan, with horizontal bearings, mounted on the vacuum chamber in which is located the dust receptacle, and direct-connected to an electric motor, or by belt to other source of power. It is built in eight sizes, for from one to six sweepers.

Fig. 2, showing a No. 2 Challenge machine in sectional elevation, is representative of all sizes. Especial attention is called to the simplicity of the machine, a feature absolutely necessary to continuous satisfactory

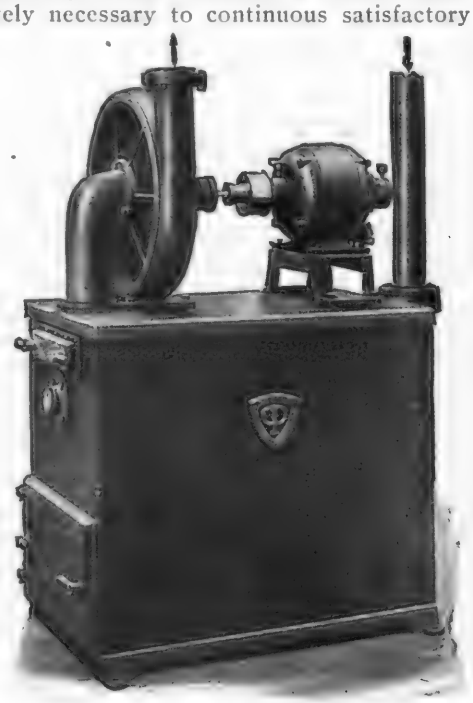


FIG. 1.—CHALLENGE VACUUM PRODUCER.

service in residences, and most desirable in larger installations. By a unique device the vacuum and air displacement are regulated to the desired point for maximum efficiency. This feature is patented.. The bearings of the fan and also of the motor are the well-known S. K. F. Swedish ball bearings and run in a continuous oil bath, insuring perfect lubrication. There are no belts, chains, pistons, cams, valves, thrust bearings, metal surfaces in sliding contact, or other complications that cause wear, trouble and waste of power.

The Challenge is based on the principle of displacing a large volume of air with a sufficient vacuum to effect thorough cleaning. The vacuum at the tool is sufficient to draw in fine dust and dirt, while the large size openings and pipes permit free passage of large coarse litter. The piping used is 2½ in. diameter or larger, according to number of tools used simultaneously. All openings are 2 in. diameter.

The advantage of large diameter piping and hose in vacuum cleaner work with respect to clogging, while important, is secondary to the reduction in power consumption.

It is well established that for efficient cleaning there is required 80 cu. ft. of air per minute at the tool for each tool in use. Using this as a standard, the following comparison of vacuum loss with pipe and hose of certain sizes will illustrate the saving in power through the use of larger pipe and hose.

In a single sweeper installation using 100 ft. of pipe and 50 ft. of hose, displacing 80 cu. ft. per minute, the vacuum loss is:

	Diameter, Inches.	Vacuum Loss, Inches.	Diameter, Inches.	Vacuum Loss, Inches.	Diameter, Inches.	Vacuum Loss, Inches.
In 100 ft. of pipe.	1¼	3.965	1½	1.849	2½	0.217
In 50 ft. of hose.	1	9.963	1¼	3.257	1¾	0.6135
Total vac. loss. ins.		13.927		5.106		0.8305

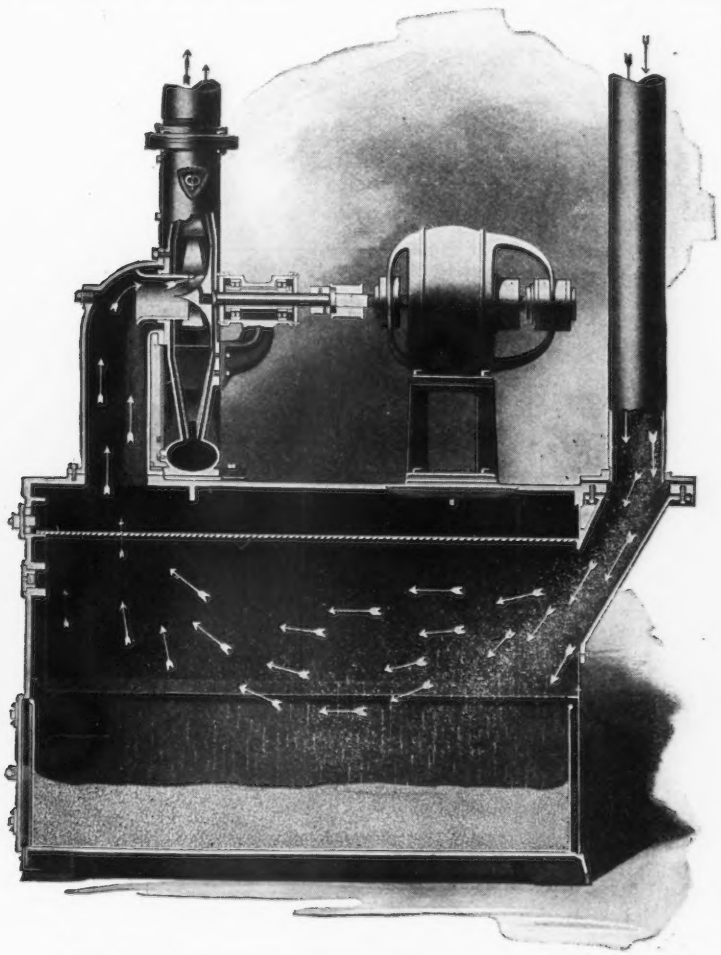


FIG. 2.—SECTIONAL ELEVATION OF NO. 2. CHALLENGE VACUUM MACHINE.

The above totals show the vacuums which it is necessary to produce at the machine in addition to the vacuum employed in useful work, i. e., cleaning, under different working conditions. Power consumed in overcoming line loss is much greater in small conduits than in the large ones.

The Challenge is a system for regular daily use. To carry out this idea the tools are designed to clean carpets and rugs, hardwood floors, walls and ceilings, radiators, upholstered furniture. There are special devices for dusting smooth surfaces, cleaning crevices, nooks, corners and all sorts of places difficult of access. The floor and carpet tools are wide, so that a large floor or rug can be gone over and thoroughly cleaned in a short time, a feature that contributes greatly to its daily usefulness.

The Challenge machine has a large gal-

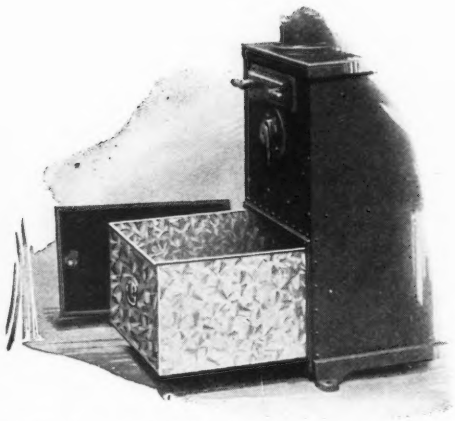


FIG. 3.—DUST RECEPTACLE OF CHALLENGE SYSTEM.

vanized steel dust receptacle in the base of the machine. The receptacle, which holds several bushels, is easily removed for emptying. Fig. 3 illustrates this feature. Another advantage, especially for residence use, is that when desired the machine may be had with separable shaft connection so that the motor may be quickly disconnected from the fan and used to drive washing machines and other household appliances.

An Insulating Material Composed of Countless Shells.

An interesting description of the principal element used in the manufacture of Nonpareil high pressure pipe covering, which is made by the Armstrong Cork Co., of Pittsburgh, was given by H. W. Prentis, Jr., manager of the company's publicity department, in an address at the recent convention of the National District Heating Association.

"Ages ago," he said, "there existed in the waters that covered the greater part of the surface of the earth, thousands of different species of microscopic plants, known as diatoms. These little plants possessed the power of forming skeletons or shells for themselves of practically pure silica, from the water in which they made their home. When death ensued, the organic matter quickly decayed and was dissolved by the water, the insoluble skeletons of silica sinking to the bottom. In the course of thousands of years, great deposits of these minute skeletons were formed, many of which are found today high and dry above the sea. Some of the beds are hundreds of feet thick, and the white chalk-like material of which they are composed is called, appropriately, diatomeous earth.

Under the microscope its peculiar structure can be clearly seen. Countless billions of tiny skeletons, each one hollow and filled with air.

For many years the heat insulating value of this earth was well known, but no method was available by which it could be bonded together in the various forms requisite for insulating purposes. This problem was finally solved, however.

As the earth is removed from the quarries or mines, it is stacked up in the open or under sheds and allowed to dry out thoroughly. It is then loaded into cars and shipped to the factory, where it is placed in storage. The first step in the manufacturing process is to reduce the earth to powder by passing it through several grinding machines. It then drops down to the mixers, where asbestos fibre is added. Then by means of an ingenious machine, the plastic mass is run into molds of the proper shape and thickness. After having been removed from the molds, the sections are placed in the driers, where they are allowed to season for a number of days. Finally, after being trimmed, sawed and

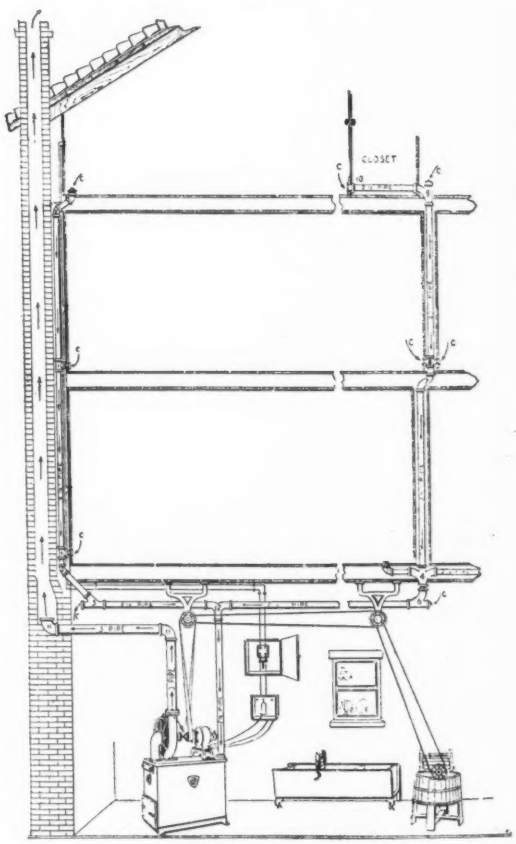


FIG. 4.—TYPICAL INSTALLATION OF CHALLENGE VACUUM CLEANING SYSTEM IN RESIDENCE, WITH INLETS AND CONTROL SWITCHES ON EACH FLOOR.

covered with canvas, the covering passes into the warehouses, ready for shipment. However, that owing to the conditions prevailing in connection with underground lines, the use of canvas jackets is not recommended. The covering should be applied without canvas and with solid brass bands or preferably copper wire instead of the lacquered ones usually supplied."

New Books

ELEMENTS OF HEATING AND VENTILATION, described as a text-book for students, engineers and architects, by Arthur M. Greene, Jr., is a work that will appeal to those who have passed beyond the elementary stages in the design of heating and ventilating plants. All phases of the work illustrated are accompanied by actual problems for which the slide rule has been used. The author states that the data presented are founded on careful experiment and may be used with confidence. Several of the methods given for the solution of problems are new. In every case the endeavor has evidently been to include all the data that are necessary to solve any problem that may arise in connection with the warming of buildings or the supply and delivery of air. Price, $2.50 net. Published by John Wiley & Sons, New York, or may be had through the book department of THE HEATING AND VENTILATING MAGAZINE.

BOYD'S WORKMEN'S COMPENSATION AND INDUSTRIAL INSURANCE, by H. T. Manning, has been received from the publishers, the Bobbs-Merrill Co., Indianapolis, Ind. It is an exhaustive treatment of the subject, in two volumes, and discusses in an eminently sane manner a subject that will probably have to be faced, if it has not already been faced, by every employer in the country. It is well worthy of perusal and study by those interested.

DIXON'S GRAPITE BRUSHES, used with electric dynamos and motors, are described in a new catalogue published by the Joseph Dixon Crucible Co., Jersey City, N. J. These brushes, being composed almost entirely of high-grade graphite, prevent sparking and wear of the commutator. Care is also taken to prevent their gumming the commutator. Other features emphasized are their low losses from friction and the automatic lubrication they impart. Complete rules are given for using the brushes under various conditions of service. Size 3x6 in. Pp. 16.

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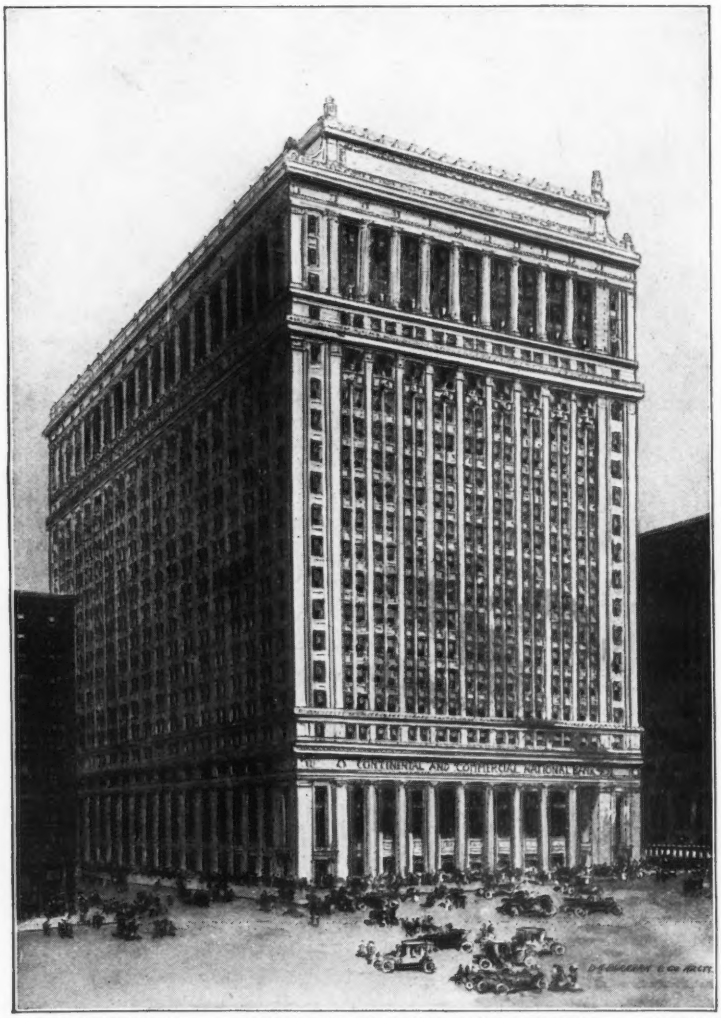

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